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# Muelleria

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# A REVISION OF THE GENUS *TEMPLETONIA* R.Br. (PAPILIONACEAE)

by

J. H. Ross\*

## ABSTRACT

The endemic Australian genus *Templetonia* is revised. Eleven species are recognized and the uncertainty concerning the application of the name *T. sulcata* (Meissn.) Benth. is discussed. This discussion includes the selection of a lectotype for *Bossiaea rossii* F. Muell., a possible synonym. Descriptions, a key to the identification of species, illustrations, and distribution maps are provided, together with notes on ecology and relationships.

Two previous papers describing *T. incana* (*Muelleria* 4: 247-249 (1980)) and *T. neglecta* (loc. cit. 390-393 (1981)) should be used in conjunction with the present revision.

## INTRODUCTION

*Templetonia*, a small genus of 11 species described by R. Brown in Ait.f., Hort. Kew. ed. 2, 4: 269 (1812), was named in honour of the Irish botanist John Templeton (1776-1825) of Orange Grove, Belfast. The genus occurs throughout much of mainland Australia and on a number of islands off Western Australia, Northern Territory and South Australia, but is absent from north-east Queensland.

Polhill (1976), in his excellent account of the Genisteae and related tribes, divided Genisteae in the sense of Bentham (1865) into four largely regional tribes, namely the Bossiaceae (Benth.) Hutch. in Australia, the Liparieae (Benth.) Hutch. in South Africa, the Crotalarieae (Benth.) Hutch. mainly in Africa and the Genisteae (Adans.) Benth. predominantly in the temperate regions of the northern hemisphere. The cumulative evidence indicated that these groups are of separate origin from a basic stock most similar to parts of the Sophoreae and Podalyrieae among living representatives. The Australian tribe Bossiaceae, of which the genus *Templetonia* is a member, comprises ten endemic genera and these ten differ more from the north temperate genera of Genisteae *sensu stricto* than do the Liparieae or Crotalarieae. The Bossiaceae are fairly readily distinguished from the rest of Genisteae *sensu lato* and from all other Australian tribes with joined stamens by characteristics of the seeds, calyx, anthers and uncomplicated styles.

The tribe Bossiaceae divides clearly into two groups, namely, *Lamprolobium* Benth., *Plagiocarpus* Benth., *Templetonia* and *Hovea* R.Br. with alternately basifixed and dorsifixed anthers having narrow connectives, collar-like lipped arils (except in *T. biloba*) and straight radicles, and *Bossiaea* Vent., *Platylobium* Sm., *Goodia* Salisb., *Aenictophyton* A. Lee, *Ptychosema* Benth. and *Muelleranthus* Hutch., with uniform dorsifixed anthers having a broad connective (the anther-slits down the face of the thecae, not lateral), usually hooded cap-like arils (absent in *Muelleranthus* and *Ptychosema*) and a slender curved radicle exerted from the cotyledons. The first group (the *Templetonia* group of genera) was found (Polhill, l.c.) to lack detectable leucoanthocyanidins and flavonols in the leaves, but tended to accumulate glycoflavones and isoflavones (or at least compounds simulating these), while the situation is reversed in the *Bossiaea* group of genera.

As indicated by Polhill, *Templetonia* exhibits a remarkable diversity in form so that segregation of other genera in the *Templetonia* group seems possible only on rather trivial features. *Hovea* differs from *Templetonia* in having the arils three or more times as long as broad, the pods not or scarcely longer than broad, and blue or purple corollas (except for the markings), *Lamprolobium* is distinguished in having

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*Muelleria* 5(1): 1-29 (1982).

a basally circumsissile calyx and imparipinnate leaves with 3-5(-7) oblong-lanceolate leaflets, whereas *Plagiocarpus* has sessile, mostly digitately 3-foliolate leaves, pods a little less than twice as long as broad and subsessile flowers with linear bracteoles. *Plagiocarpus* is clearly closely allied to *Templetonia* but the combination of diagnostic characters distinguishes it from *Templetonia*. Although the species in *Templetonia* represent a rather heterogeneous assemblage, all of them have in common and are distinguished from the other genera in the group by the possession of pods which are more than twice as long as broad and usually ovate bracteoles. Except for *T. egena* and *T. battii* which are obviously very closely related and *T. sulcata* which clearly is related to these two species, affinities elsewhere in the genus are difficult to detect. *T. stenophylla* appears to be allied to *T. neglecta* but the remaining species appear fairly isolated and without close allies.

In habit all species are invariably shrubs or subshrubs with woody rootstocks although there is one record (presumably correct) of *T. retusa* in Western Australia growing as a tree up to six metres high. In *T. aculeata* the stipules are spinescent but in all other species they are non-spinescent and, except in *T. incana*, inconspicuous. In *T. egena*, *T. battii* and *T. sulcata* the leaves are reduced to minute scales up to 1 mm long so that the plants have the appearance of being leafless. In *T. drummondii* the leaves are unifoliolate and in *T. hookeri* vary from 1-foliolate to digitately or pinnately 3-5-foliolate whereas in all remaining species the leaves are simple (*T. aculeata* is occasionally leafless). Despite the occurrence of unifoliolate leaves in *T. drummondii* and in *T. hookeri*, where pinnately or digitately 3-5-foliolate leaves also occur, the two species are not at all closely related. The paired bracteoles which invariably occur at or above the middle of the pedicel are ovate except in *T. biloba* and *T. incana* where they are linear. In *T. retusa* and *T. incana* the flowers are large and mostly red throughout although in the former white and yellow variants occur sporadically and in the latter some petals are sometimes partly yellow or cream. In all other species the flowers are smaller, basically yellow and brown or purplish-brown and relatively inconspicuous. The shape and structure of the corolla in *T. retusa* differs from that of the other species and suggests that it is adapted for a different means of pollination.

## TAXONOMY

**Templetonia** R.Br. in Ait.f., Hort. Kew., ed. 2, 4: 269 (1812); DC., Prodr. 2: 118 (1825); G. Don, Gen. Syst. 2: 129 (1832); Benth., Fl. Austr. 2: 168 (1864); Benth. & Hook.f., Gen. Pl. 1: 474 (1865); Taub. in Engl., Pflanzenfam. 3, 3: 217 (1893); Diels & Pritzel, Bot. Jahrb. 35: 263 (1904); Hutch., Gen. Fl. Pl. 1: 349 (1964); Polhill, Bot. Syst. 1: 309 (1976). TYPE SPECIES: *T. retusa* (Vent.) R.Br.

*Nematophyllum* F. Muell., Hook. J. Bot. & Kew Gard. Misc. 9: 20 (1857).

*Shrubs or subshrubs* with one to several stems arising from a woody rootstock; branches usually ridged or longitudinally striate, terete or sometimes flattened, occasionally spine-tipped. *Leaves* alternate or rarely several at a node, simple, unifoliolate or rarely digitately to pinnately 3-5-foliolate, or sometimes reduced to minute scales, the lower nerves usually strongly ascending, apiculate, pungent or bilobed apically, often with a mass of fine glandular processes in the axils; leaflets, when present, terete to linear-filiform or ovate to narrow-elliptic or obovate-oblong. *Stipules* usually small and inconspicuous, occasionally spinescent; stipels present in unifoliolate and compound leaves. *Flowers* yellow and brown or purplish-brown, red or occasionally red and cream or white or yellow, 1-several from the axils, usually subtended by a few small scales as well as the bract and with a pair of usually ovate papery bracteoles near the middle or on the upper part of the pedicel, less often the bract and bracteoles linear. *Calyx* one-quarter to two-thirds as long as the corolla, persisting in fruit; upper lobes either largely united or much broader than the others, lower lobes often as long as the upper, the lowest often the longest. *Corolla* varied in structure; standard narrow-elliptic to orbicular or slightly oblate,

reflexed, with a well developed claw; keel and wing petals short and broad to long and narrow, usually with a well developed claw and auricled. *Stamen*-filaments joined in a sheath split open on one side; anthers alternately basifixed and dorsifixed, the latter usually shorter. *Style* usually slender, curved, with a small terminal stigma. *Pods* sessile to stipitate, narrow-oblong to oblong-elliptic, more than twice as long as broad, (1-) 2-several-seeded, the valves coriaceous, convex, separating along both sutures. *Seeds* elliptic to ovate, compressed, with a small hilum near one end surrounded by a collar-like often lipped or less often a cap-like (*T. biloba*) aril; radicle short, straight.

#### KEY TO SPECIES

1. Stipules spinescent, spreading or recurved and up to 1 cm long ..... 8. *T. aculeata*
1. Stipules not spinescent
  2. Plant leafy, the leaves simple, unifoliate or digitately to pinnately 3-5-foliolate
    3. Leaves simple
      4. Stipules conspicuous, 4-11 x 2.5-6 mm; stipules, young branchlets, leaves and inflorescences clothed with a dense greyish velvety indumentum ..... 2. *T. incana*
      4. Stipules inconspicuous, up to 2 mm long; stipules, branchlets, leaves and inflorescences glabrous to densely pubescent but the indumentum not as above
        5. Stems sparingly to densely clothed with long villous hairs; leaves typically bilobed apically and the two lobes diverging somewhat, margins revolute; calyx densely clothed with dark brown villous hairs when young ..... 3. *T. biloba*
        5. Stems glabrous; leaves obtuse, emarginate or slightly mucronate apically but not bilobed, margins not revolute; calyx glabrous outside except for hairs on the apices of the lobes
          6. Flowers red (very occasionally white or yellow); standard elliptic, 2.7-3.4 cm long; pods 3.5-8 cm long; leaves broadly obovate to almost rotund or narrowly cuneate-oblong to oblanceolate, 0.3-2.6 cm wide ..... 1. *T. retusa*
          6. Flowers yellow and brown or purplish-brown; standard orbicular, 0.95-1.6 cm long; pods 1.6-3 cm long; leaves narrow-oblong to slightly obovate- or linear-oblong, 0.2-0.55 (0.7) cm wide
            7. Stems erect, prostrate or straggling; leaves (0.8) 1.8-5(7) cm long; pods obliquely oblong-elliptic on a stipe which exceeds the calyx; occurs in SE. South Australia and the eastern States ..... 4. *T. stenophylla*
            7. Stems erect; leaves (0.45) 0.7-2.2(3.8) cm long; pods oblong, on a stipe as long as or just exceeding the calyx; confined to Western Australia ..... 5. *T. neglecta*
      3. Leaves unifoliate or digitately to pinnately 3-5-foliolate
        8. Leaves unifoliate; petiole distinctly sulcate adaxially; lamina ovate to narrow-elliptic or obovate-oblong; flowers on pedicels up to 0.75 cm long ..... 6. *T. drummondii*
        8. Leaves unifoliate or digitately to pinnately 3-5-foliolate; petiole not as above; leaflets linear-terete to filiform; flowers on filiform pedicels 2-2.5 cm long ..... 7. *T. hookeri*
    2. Plant appearing leafless, the leaves reduced to scales up to 1 mm long
      9. Stems terete
        10. Slender shrub to 3 m high, branches lax, not terminating in pungent points; style slender, with a small stigma; pods 1.3-2.6 x 0.6-1 cm; seeds 7.5-10(13.5) mm long, margin of aril frilly ..... 9. *T. egena*
        10. Compact divaricate shrub to 1.4 m high, branches rigid, intricately branched, terminating in pungent points; style short, thickened, with a large flattened stigma; pods 1.2-1.5 x 0.5-0.65 cm; seeds 4.8-5 mm long, margins of aril deeply incised ..... 10. *T. battii*
      9. Stems distinctly flattened ..... 11. *T. sulcata*

1. **Templetonia retusa** (Vent.) R.Br. in Ait. f., Hort. Kew ed. 2, 4: 269 (1812); Ker in Edwards's, Bot. Reg. 5: t. 383 (1819); Lodd., Bot. Cab. 6: t. 526 (1821); Sims in Curtis's, Bot. Mag. 49: t. 2334 (1822); Meissn. in Lehm., Pl. Preiss. 1: 88 (1844-45); Benth., Fl. Austr. 2: 169 (1864); Diels & Pritzl, Bot. Jahrb. 35: 264 (1904); J. M. Black, Fl. S. Austr. ed. 2: 446 (1948). *Rafnia retusa* Vent., Jardin de la Malmaison 1: t. 53 (1804). Type: Herb. Ventenat (G, holo., MEL, photo!).



*Templetonia glauca* Sims in Curtis's Bot. Mag. 46: 2088 (1819); Lodd., Bot. Cab. 7: t. 644 (1822); Ker in Edwards's, Bot. Reg. 10: t. 859 (1825). Type: Curtis's Bot. Mag. t. 2088 (iconotype!).

Much-branched glabrous and sometimes somewhat glaucous shrub 0.3-4 m high or occasionally (fide B. L. Turner 5548) a tree to 6 m high; branches greenish-yellow to yellowish-brown, angular and sometimes slightly winged, unarmed. *Stipules* inconspicuous. *Leaves* simple, extremely variable in size and shape, broadly obovate to almost rotund to narrowly cuneate-oblong or oblanceolate, (0.5-) 1.5-3.5 (-6) x (0.3-) 0.6-1.4 (-2.6) cm, slightly to distinctly emarginate apically or minutely mucronate, nearly sessile or articulating on a short thick petiole, thickly coriaceous, venation often fairly conspicuous on the lower surface, glabrous, sometimes glaucous, with a mass of fine dark glandular processes in the axils. *Flowers* 1 or 2 per axil, large and showy, red or occasionally white or yellow, on glabrous pedicels 0.6-2 cm long, the pedicels with a pair of ovate bracteoles up to 2.5 x 2 mm near or above the middle; bracteoles glabrous or with an apical fringe of hairs. *Calyx* 0.75-1.15 cm long, the lobes much shorter than the tube, the upper much broader than the others, the lowest lobe longest, glabrous except for marginal cilia on the apices of the lobes. *Standard* elliptic, 2.7-3.4 cm long including a basal claw up to 0.5 cm long, 1-1.8 cm wide, slightly emarginate apically; wings 2.5-3.3 cm long including a claw up to 0.4 cm long, 0.4-0.65 cm wide, auricled; keel petals lightly united, 2.6-3.3 cm long including a claw up to 0.45 cm long, 0.4-0.75 cm wide, auricled. *Stamens* up to 3.3 cm long, anthers alternately basifixed and dorsifixed but not as conspicuously as in most other species. *Ovary* up to 12 mm long, on a stipe up to 5 mm long, glabrous. *Pods* oblong, sometimes obliquely so, 3.5-8 x 0.95-1.6 cm, on a stipe up to 1 cm long which usually exceeds the persistent calyx, usually with a distinct apical or lateral beak, mostly 4-12-seeded, valves coriaceous, glabrous, compressed. *Seeds* elliptic, 5-7 x 3-4 x 2-2.8 mm, yellowish- to reddish-brown, separated by transverse frass-like partitions, the small hilum surrounded by a collar-like aril with a raised lateral lip (Fig. 1).

*T. retusa* occurs in Western and South Australia (and on some of the off-shore islands) and is found most frequently on limestone or on sand or loam overlying limestone (Fig. 2).

#### REPRESENTATIVE SPECIMENS EXAMINED:

*Western Australia* – Guilderton (mouth of Moore river), 2.vii.1961, A.S. George 2615 (PERTH). 3.2 km SW. of Mt. Ragged, 6.xii.1960, A.S. George 2061 (PERTH). Fitzgerald River Reserve, ± 20 km N. of mouth of Fitzgerald river, 24.vii.1970, G. J. Keighery 718 (PERTH).

*South Australia* – Flinders Range, Parachilna Gorge, 10 km W. of Blinman, 3.x.1962, T.R.N. Lothian 1096 (AD 96312021). Eyre Peninsula, Kirton Point at Port Lincoln, 14.ix.1970, B. J. Copley 3090 (AD 97137104). Fowlers Bay, 3.x.1975, R. J. Chinnock 2736 (AD 97545040).

#### NOTES:

*T. retusa* shows considerable variation in leaf size and shape. In habit it varies from a small to a large shrub 0.3-4 m high although one specimen, B. L. Turner 5548 (PERTH) from 128 km ENE. of Esperance, Western Australia, was described as a tree 8-20 feet high.

*T. retusa* is widely cultivated on account of its attractive flowers. The corolla is usually red but an occasional white or yellow-flowered variant occurs irregularly throughout the distributional range of the species. The red corolla with narrow interlocked wing and keel-petals suggests that the species is adapted to different pollinators than other members of the genus. Polhill (1976) suggested that the flowers are modified to at least facilitate facultative pollination by birds and careful field observations are required to confirm this.

Information on the depredation of *T. retusa* by the larvae of *Uresiphita ornithopteralis* (Guenee) is given by Sims (1980).

*T. retusa* is probably the best known species in the genus and is easily distinguished from all except *T. incana* by its large red flowers. *T. incana* differs in



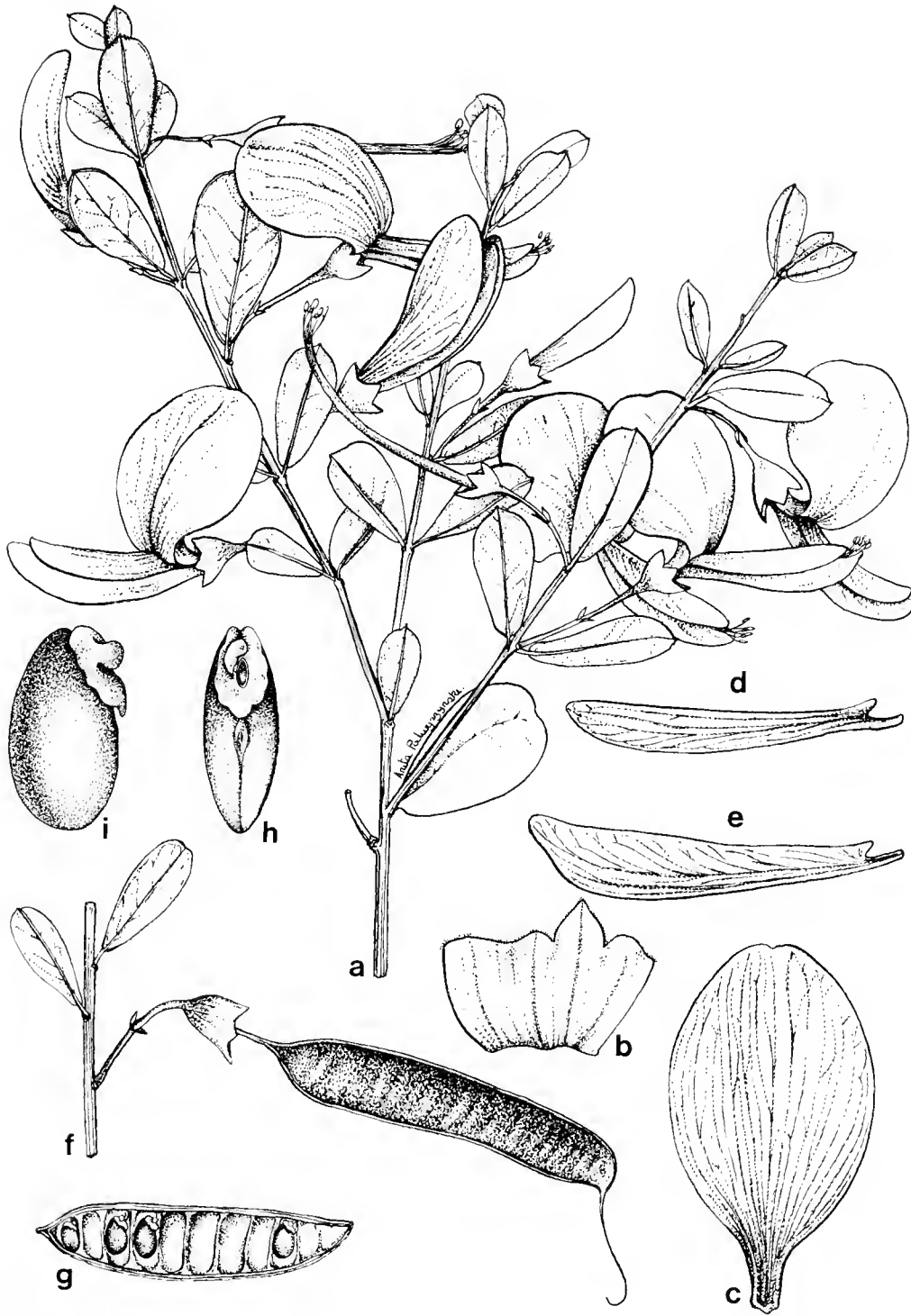


Fig. 1. *Templetonia retusa*. a—flowering twig, x 1; b—calyx opened out (upper lobe on left), x 1½; c—standard, x 1½; d—wing petal, x 1½; e—keel petal, x 1½; f—fruiting twig, x 1; g—internal view of pod-valve showing transverse frass-like partitions separating the seeds, x 1; h—seed, hilar view, x 5; i—seed, side view, x 5. a—e from M. E. Phillips (CBG 036928); f from R. L. Specht 2645 (AD 96109039); g—i from J. W. Wrigley (CBG 036539).

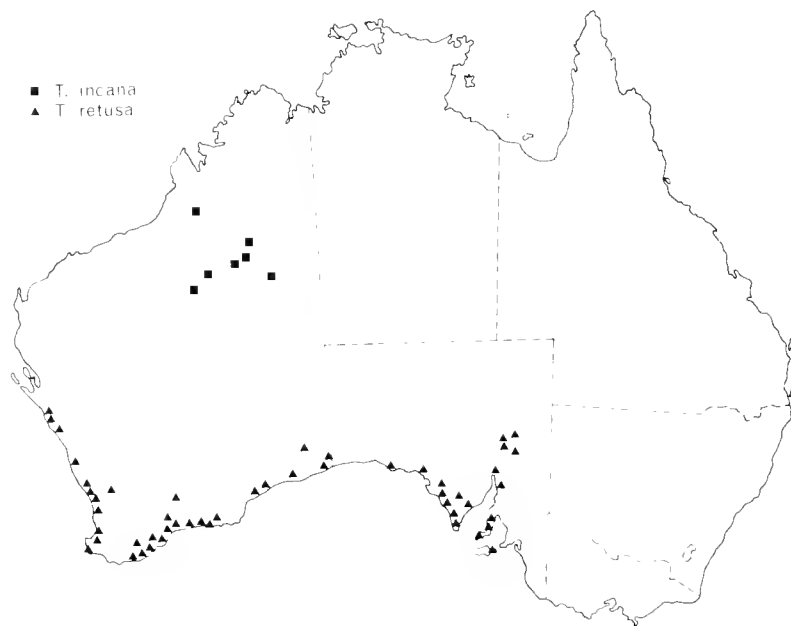


Fig. 2. The known distributions of *Templetonia incana* and *T. retusa*.

being densely clothed with a greyish-white spreading velvety indumentum, in having differently shaped corollas and leaves, large stipules and in several other ways.

2. ***Templetonia incana*** J. H. Ross, *Muelleria* 4: 247 (1980). Type: Western Australia, 30.4 km E.N.E. of Jupiter Well, 22° 46' S, 126° 51' E, 28.vii.1967, A. S. George 9065 (PERTH, holo.! AD!, CANB!, K!, MEL!, PERTH! iso.)

*T. incana* is a very distinctive species which is readily distinguished from all others in the genus by the dense greyish-white velvety spreading indumentum on the young stems, leaves, stipules, pedicels, bracts, bracteoles and calyces, by the large simple leaves and the conspicuous stipules. A full account with detailed description and illustration is provided in Ross, loc. cit. 247-249, q.v.

*T. incana* is fairly widely distributed in sandy soils in the Gibson, Great and Little Sandy Deserts in Western Australia. (Fig. 2).

3. ***Templetonia biloba*** (Benth.) Polhill, *Bot. Syst.* 1: 309 (1976). *Bossiaea biloba* Benth. in Hügel, *Enum. Pl. Nov. Holl.* 36 (1837); Walp., *Repert. Bot. Syst.* 1: 578 (1842); Meissn. in Lehm., *Pl. Preiss.* 1: 85 (1844-45); Benth., *Fl. Austr.* 2: 160 (1864). Type: Western Australia, Albany, King Georges Sound, Hügel (W, holo.!).

*Bossiaea biloba* var. *stenophylla* Meissn. in Lehm., *Pl. Preiss.* 1: 85 (1844-45). Type: Western Australia, Swan River, Drummond 264 (MEL 92288!, W!).

Small shrub or subshrub up to 0.5 m high with several simple or branched stems, the stems rigid, ± terete to slightly angular, mostly densely clothed with long villous hairs but sometimes only sparingly so, unarmed. *Leaves* simple, ± sessile, the basal articulation usually densely villous, very variable in size and shape from linear-cuneate or cuneate-oblong and up to 2.5 cm long x 0.7-1.5 cm wide to linear or linear-oblong and up to 6 cm long x 0.4 cm wide, typically bilobed apically and the two lobes diverging somewhat or apex obtuse or only slightly emarginate, the midrib projecting slightly and forming a short mucro, margins revolute, mostly glabrous apart from hairs on midrib and margins but sometimes densely clothed with hairs above and/or below or ± glabrous throughout. *Flowers* 1 or 2 per axil, on sparingly to densely villous pedicels up to 9 mm long, the pedicels with a basal linear villous bract up to 3.5 mm long and an apical pair of linear villous bracteoles

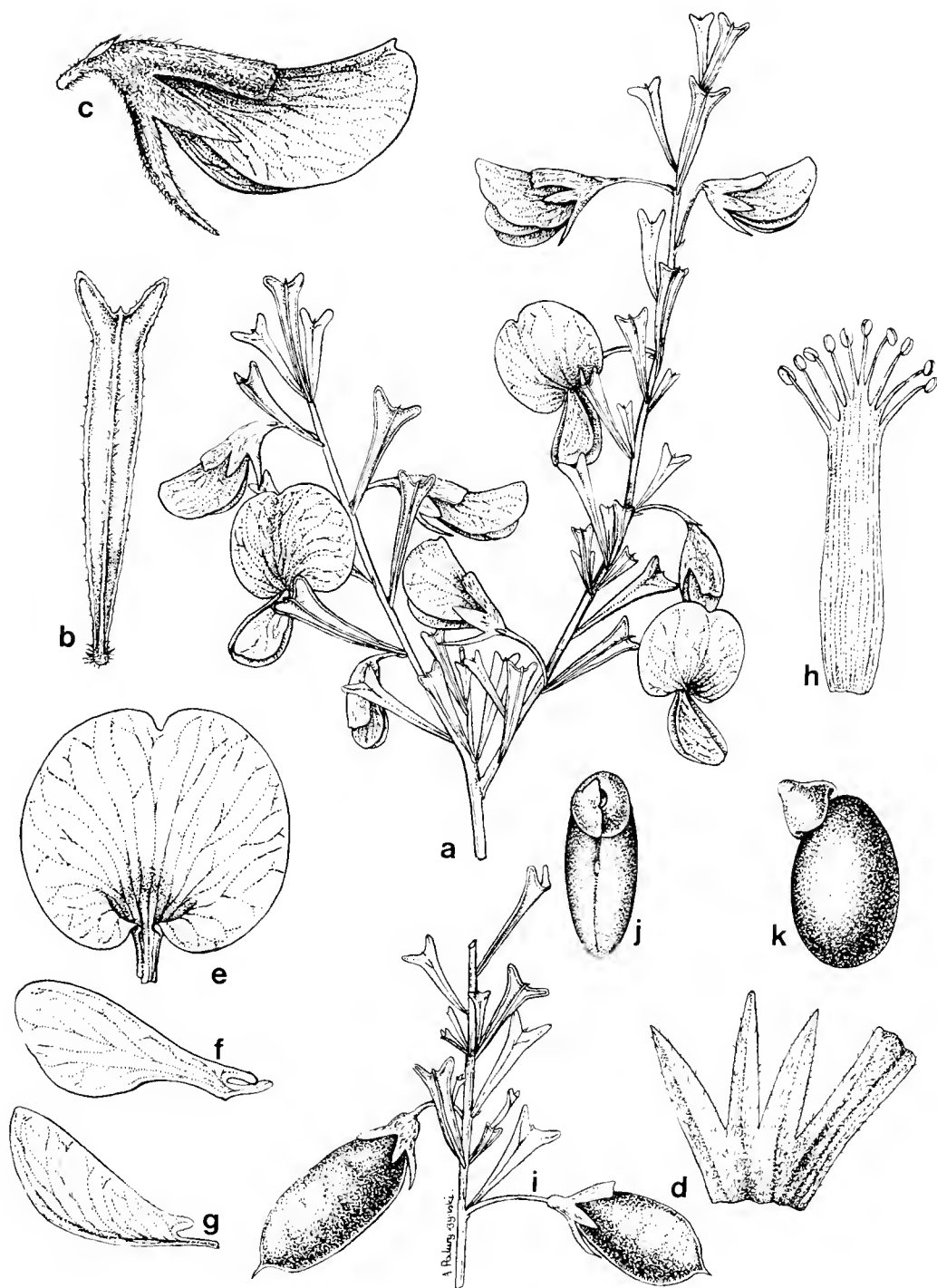


Fig. 3. *Templetonia biloba*. a—flowering twig, x 1; b—leaf, x 2; c—side view of flower, x 2; d—calyx opened out (upper lobes on right), x 2; e—standard, x 2; f—wing petal, x 2; g—keel petal, x 2; h—staminal tube opened out, x 3; i—fruiting twig, x 1; j—seed, hilar view, x 4; k—seed, side view, x 4. a, e—h, from J. Seabrook 29 (PERTH); b from E. Pritzel 273 (PERTH); i—k from Lullfitz L 1807 (PERTH).

up to 2.5 mm long. *Calyx* 8-12 mm long, the two upper lobes united into a broad truncate-emarginate lip, the lower lobes lanceolate, the lobes longer than the tube, densely clothed outside with dark brown villous hairs which become greyish-white with age, silky pubescent within. *Standard* orbicular, 12-16 mm long including a claw up to 6 mm long, 9-12 mm wide, emarginate apically, pale yellow inside with a deep yellow basal horseshoe-shaped throat surrounded by a broad purplish-brown band; wings 10-15 mm long including a claw up to 3 mm long, 4-4.5 mm wide, auricled, pale yellow except for a purplish-brown area extending from the base; keel petals lightly united, 12-15 mm long including a claw up to 3 mm long, auricled. *Stamens* up to 16 mm long. *Ovary* subsessile or very shortly stipitate, up to 4.5 mm long, glabrous. *Pods* oblong, sometimes obliquely so, usually with an acute apical beak, 2.2-3 x 0.9-1.2 cm, very shortly stipitate but stipe not exceeding the calyx, 3-5-seeded, with transverse septa between the seeds, valves coriaceous, glabrous. *Seeds* elliptic, 4-5 x 2.5-3.5 mm and up to 2.75 mm thick, chestnut-brown, the small hilum surrounded by a large cap-like aril (Fig. 3).

*T. biloba* is confined to the Irwin and Darling Botanical Districts of the Southwestern Botanical Province of Western Australia as defined by Beard (1980) where it occurs on sandy soils or gravel (Fig. 4).

#### REPRESENTATIVE SPECIMENS EXAMINED:

*Western Australia*—Swan River, 1843, *Preiss 1061* (MEL 92286). Lake Matilda, King Georges Sound, *Oldfield* (MEL 92287). Midland Junction, 9.vii.1898, *A. Morrison* (MEL 92285). Serpentine, S. of Armadale on road to Pinjarra, v. 1901, *L. Diels & E. Pritzel* (PERTH). Swan View (Perth), ix.1902, *C. Andrews* (PERTH). Darlington, 19.vi.1949, *R. D. Royce 3061* (PERTH). S. of Muchea, Geraldton Highway, 26.vii.1959, *A. S. George 47* (PERTH). N. of Geraldton, 29.vii.1961, *R. D. Royce 6456* (PERTH). Bushmead, 1.xii.1962, *F. Lullfitz L1807* (PERTH). Helena Valley, 3.vii.1977, *J. Seabrook 29* (PERTH).

#### NOTES:

*T. biloba* was transferred from *Bossiaea* by Polhill (1976) as the species was found to have the anthers, seeds and flavonoid pattern of *Templetonia* and to be more satisfactorily accommodated within this genus. The cap-like aril with high sides in *T. biloba* approaches the form found in *Bossiaea* but is not hooded as is usually the case in *Bossiaea*, while the linear bract near the base of the pedicel and the similarly shaped bracteoles near the apex show an approach to the situation in *Hovea*.

Leaf size and shape in *T. biloba* are variable but in their typical form the cuneate-oblong leaves with bilobed apices are very distinctive. *Drummond 264*, the type of *Bossiaea biloba* var. *stenophylla* Meissn., is a narrow-leaved variant in which the apices are mostly obtuse or only slightly emarginate and not conspicuously bilobed although a few of the basal leaves are cuneate-oblong and bilobed apically. Some of the basal leaves in the specimen of *Drummond 264* housed in the Naturhistorisches Museum Wien (W) are more distinctly bilobed apically than are those on the Drummond specimen in MEL. This mixture of basal cuneate-oblong leaves with emarginate apices and upper linear-oblong leaves can be seen also in other specimens, for example *Royce 6456* (PERTH) from N. of Geraldton. There is a tendency for the narrow-leaved variant lacking conspicuously bilobed apices to occur more frequently in the northern part of the species range, particularly in the Geraldton-Mullewa region, but it is not considered worthy of formal taxonomic recognition.

*T. biloba* is readily distinguished from the other species in the genus by the leaves which are typically bilobed apically, the calyx with the upper lobes united into a broad truncate-emarginate lip and densely clothed with dark brown villous hairs outside, and the cap-like aril on the seeds.

4. *Templetonia stenophylla* (F. Muell.) J. M. Black, Fl. S. Austr. ed. 1: 304 (1924); ed. 2: 446 (1948); Domin, Biblioth. Bot. 89: 728 (1925); Willis, Handb. Pl. Vict. 2:



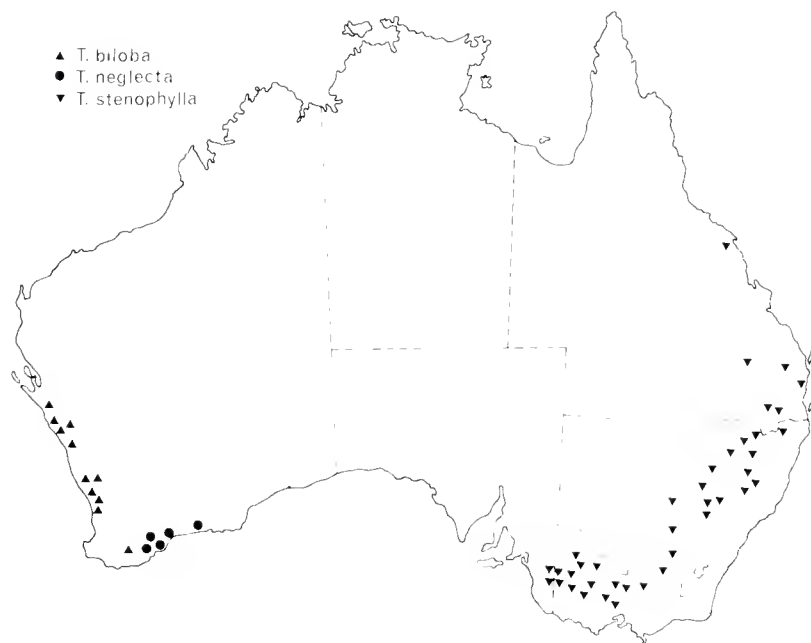


Fig. 4. The known distributions of *Templetonia biloba*, *T. neglecta* and *T. stenophylla*.

281 (1973). *Bossiaea stenophylla* F. Muell., *Fragm. Phyt. Austr.* 1: 9 (1858). Type: Victoria, near Melton, *M. Weidenbach* (MEL 20338, holo!).

*Templetonia muelleri* Benth., *Fl. Austr.* 2: 169 (1864), nom. illegit. Syntypes: Queensland, Wide Bay, *Bidwill* (K-photo!), *Leichhardt* (MEL 1516495!). New South Wales, Hawkesbury river, *R. Brown* (BM-photo!); Cugeegong river, *A. Cunningham* (BM and K-photos!); New England, near Tenterfield, *C. Stuart* (K-photo! MEL 1516496! MEL 1516497! MEL 1516502!). Victoria, Murray river, *Prince Paul Wilhelm* (MEL 151650!); Wimmera river, *Dallachy* (K-photo! MEL 1516499! MEL 1516500! MEL 1516503!) and Mount Arapiles, near Lake Hindmarsh, *Dallachy*, (MEL 1516494!); Melton, near Port Phillip, *Weidenbach* (MEL 20338!).

Small glabrous shrub or subshrub up to 0.6 m high with one to several simple or branched erect, prostrate or straggling stems, the stems  $\pm$  terete to somewhat angular especially apically, faintly or distinctly longitudinally striate, unarmed. *Stipules* inconspicuous, up to 1 mm long, broad-triangular. *Leaves* simple, more or less sessile, articulated basally, the lower ones narrow-oblong or oblong and the upper sometimes linear-oblong or linear, (0.8)1.8-5(7) cm long, 0.2-0.55(0.7) cm wide, glabrous, apex obtuse or with a short recurved mucro, venation on lower surface sometimes fairly conspicuous, with a mass of fine dark glandular processes in the axils. *Flowers* 1 or 2 per axil, on glabrous pedicels 4-8 mm long (up to 13 mm long in fruit), the pedicels with a basal bract up to 1.5 mm long and a pair of ovate bracteoles 1.5-2.5 x 1.2-2 mm at or above the middle of the pedicel; bracteoles glabrous or with an apical fringe of hairs. *Calyx* up to 8 mm long, the two upper lobes united except for the short acute apices, the lowest lobe slightly longer than the others, the lobes shorter than the tube, glabrous outside except for a fringe of hairs on the apices of the lobes. *Standard* orbicular, 10-15 mm long including the claw, 8-10 mm wide, emarginate apically, pale yellow inside with a deep yellow basal horseshoe-shaped throat surrounded by a purplish-brown fringe; wings up to 12.5 mm long including a claw up to 2.5 mm long, up to 4.5 mm wide, auricled, usually brown or purplish-brown throughout or pale yellow towards the apex; keel petals lightly united, up to 12.5 mm long including a claw up to 4 mm long, up to 5.5 mm



Fig. 5. *Templetonia stenophylla*. a—flowering twig, x 1; b—leaf, x  $1\frac{1}{2}$ ; c—side view of flower, x 3; d—calyx opened out (lower lobe on left), x 3; e—standard, x 3; f—wing petal, x 3; g—keel petal, x 3; h—fruiting twig, x 1; i—seed, hilar view, x 6; j—seed, side view, x 6. a—g from A. C. Beaglehole 30912 (MEL 1516457); h from A. C. Beaglehole 39636 (MEL 1516456); i and j from J. L. Boorman (NSW 44608).

wide, auricled, usually brown or purplish-brown throughout or pale yellow towards the apex. *Stamens* up to 14 mm long. *Ovary* stipitate, up to 8 mm long, glabrous. *Pods* obliquely oblong-elliptic, narrowed to an acute lateral beak apically, 1.6-2.6 x 0.85-1.05 cm, on a stipe up to 0.5 cm long which exceeds the calyx, 1-3-seeded; valves coriaceous, convex, glabrous. *Seeds* elliptic, 3.6-4.8 x 2-2.7 mm and up to 1.2 mm thick, reddish-brown, the small hilum surrounded by a collar-like aril with a raised lateral lip (Fig. 5).

*T. stenophylla* is fairly widely distributed extending from south-east Queensland southwards through eastern and central New South Wales, central and western Victoria to the south-east corner of South Australia in the vicinity of Bordertown (Fig. 4). The species favours dry *Eucalyptus* forest, stream banks and open situations, often on poor grey loam.

#### REPRESENTATIVE SPECIMENS EXAMINED:

*South Australia*—Bordertown, 22.viii.1940, *J. B. Cleland s.n.* (AD 966080577).  $\pm$  8 km NE. of Wolsley, ix.1961, *K. Alcock* 3 (AD 96204100).  $\pm$  16 km N. of Frances, 1.x.1972, *M. Beek* 109 (AD 97244137).

*Queensland*—Wide Bay Distr.,  $\pm$  6 km S. of Kilkivan, Serpentine-Black Snake road, x.1959, *W. F. Ridley* QSC267 (BRI 32548). Burnett Distr., Burrandowan road (near Hodges Dip), 26.viii.1975, *Kingaroy Shire Council* (BRI 197018). Darling Downs Distr., Kragra, ix.1978, *G. Lithgow* 40 (BRI 242638).

*New South Wales*—Dubbo, xi.1905, *J. L. Boorman* (NSW 44608). Wyalong, 22.ix.1906, *J. L. Boorman* (NSW 44616). Warrumbungle National Park, near track to "Fans Horizon", 12.ix.1977, *M. G. Corrick* 5891 (MEL 1516462).

*Victoria*—Ironstone Hill, near Bendigo, ix.1920, *D. J. Paton* (MEL 92142). Mt. Arapiles, NW side, 6.ix.1969, *A. C. Beaglehole* 30912 (AD 97714008, MEL 1516457). Northern fringe of Little Desert, township of Kiata, 2.ix.1979, *M. G. Corrick* 6297 & *B. A. Fuhrer* (MEL 559337).

#### NOTES:

The description of *Bossiaea stenophylla* F. Muell., the basionym of *Templetonia stenophylla* (F. Muell.) J. M. Black, was based on a specimen collected by Weidenbach from "Prope oppidulum Milton in vicinia portus Phillip" and this specimen, which is also a syntype of *T. muelleri* Benth. nom. illegit., is housed in MEL (MEL 20338). I have been unable to trace a locality called Milton in the vicinity of Port Phillip and the label on MEL 20338 suggests that the locality is Melton rather than Milton: there is no suggestion of a dot above the second letter of the name and it is probable that Milton is a typographical error. The closest recorded occurrence of *T. stenophylla* to Port Phillip is from the Djerriwarrh Creek some 46 km NW. of Melbourne and a few kilometres west of Melton.

*T. stenophylla* appears to be most closely related to *T. neglecta*, a rare species with a restricted distribution in the Eyre Botanical District of the Southwestern Botanical Province of Western Australia as defined by Beard (1980), and from which it is separated by a large geographical discontinuity. Like *T. neglecta*, plants of *T. stenophylla* tend to be inconspicuous when not in flower.

*T. neglecta* differs from *T. stenophylla* in that the leaves tend to be smaller, more congested on the stems and of a different shape and texture, the flowers are always solitary in the leaf axils, and the pods are oblong and on a stipe as long as or only just exceeding the persistent calyx.

5. *Templetonia neglecta* J. H. Ross, *Muelleria* 4: 390 (1981). Type: Western Australia, 11 km N.W. of Black Head, 34°31'S, 118°48'E, 6.viii.1974, *K. Newbey* 4273 (PERTH, holo.!).

A full account of this species with detailed description and illustration is provided in Ross, loc. cit. 390-392, q.v.

*T. neglecta* shows no obvious affinity with any other *Templetonia* species in Western Australia although some sterile small-leaved specimens of *T. retusa* show a fairly close superficial resemblance to sterile specimens of *T. neglecta*. However, *T. retusa* is a very distinctive species which is readily distinguished from *T. neglecta* when in flower or fruit. *T. neglecta* appears to be most closely related to *T.*



*stenophylla* from which it is separated by a large geographical discontinuity. The differences between *T. neglecta* and *T. stenophylla* are given under the latter.

*T. neglecta* is a rare species with a restricted distribution in the Southwestern Botanical Province of Western Australia, being confined to the Eyre Botanical District as defined by Beard (1980). (Fig. 4).

6. ***Templetonia drummondii*** Benth., Fl. Austr. 2: 169 (1864); Diels & Pritzel, Bot. Jahrb. 35: 265 (1904). Type: Western Australia, *Drummond* (K, holo., MEL, photo!).

Small glabrous subshrub with several prostrate or ascending stems up to 30 cm long, stems faintly longitudinally striate and  $\pm$  terete to distinctly angled especially apically, unarmed. *Stipules* up to 2 mm long, broad-triangular. *Leaves* unifoliate, with a mass of fine dark glandular processes in the axils; petiole up to 5 mm long, articulated basally, distinctly sulcate adaxially, with a pair of subulate stipellae up to 2 mm long at the apex, the apices of the stipellae often diverging; lamina articulated basally, the lower leaves ovate to almost obovate and smaller than the upper leaves which are narrow-elliptic to elliptic- or obovate-oblong, (0.5)1.5-3.5(4.8)  $\times$  (0.4)0.5-0.8(1.4) cm, glabrous, mucronate apically, venation on lower surface sometimes fairly conspicuous. *Flowers* solitary, axillary, on glabrous pedicels up to 7.5 mm long, the pedicels with a basal bract up to 1.5 mm long and a pair of ovate bracteoles up to 2.2 mm long at or above the middle, glabrous except for a fringe of apical cilia and with dark glandular processes in the axils. *Calyx* up to 5.5 mm long, the two upper lobes united except for the short acute apices, the lowest lobe slightly longer than the others, especially in fruiting material, glabrous outside except for a fringe of hairs on the apices of the lobes, pubescent within. *Standard* oblate, up to 14 mm long including a claw up to 3 mm long, 10-12 mm wide, emarginate apically, brownish- or purplish-yellow outside, yellow inside with a deep yellow basal horseshoe-shaped throat surrounded by a narrow brown or purplish-brown band; wings up to 10.5 mm long including a claw up to 2.5 mm long, up to 4.2 mm wide, auricled, yellow with brown to purplish-brown near the base; keel petals lightly united, up to 12 mm long including a claw up to 2.5 mm long, up to 3.5 mm wide, auricled, yellow with a purplish-brown tip. *Stamens* up to 12 mm long. *Ovary* almost sessile, up to 6 mm long, 4-6-ovulate, glabrous. *Pods* oblong, with an acute apical beak, 1.8-2.8  $\times$  0.85-1 cm, on a short stipe which does not exceed the calyx, mostly 4-5-seeded, valves coriaceous, glabrous, convex. *Seeds* elliptic, 4-4.5  $\times$  3-3.2  $\times$  2.2-2.5 mm, olive-brown, the small hilum surrounded by a collar-like aril with a raised lateral lip (Fig. 6).

*T. drummondii* has a restricted distribution in the Southwestern Botanical Province of Western Australia being confined to the Drummond and Dale subdistricts of the Darling Botanical District as defined by Beard (1980) where it favours laterite or sandy-clay soil. Hartley & Leigh (1979) considered *T. drummondii* to be endangered and in serious risk of disappearing from its native habitat within one or two decades if present land use and other casual factors continue to operate (Fig. 7).

#### SPECIMENS EXAMINED:

*Western Australia*—Midland Junction, viii.1900, *W. V. Fitzgerald s.n.* (PERTH). Parkerville, E. of Perth, off Toodyay Rd., viii.1902, *C. Andrews* (PERTH). 68 mile peg on Geraldton Rd., 1.viii.1952, *R. D. Royce 3838* (PERTH). Corner of Pomeroy and Edward Rd., Lesmurdie, 16.viii.1965, *A. S. George 6770* (PERTH). Top of Welshpool Hill, 10.xi.1965, *A. S. George s.n.* (PERTH). 66 mile peg, Gt. Northern Highway, 30.viii.1966, *A. S. George 7789* (PERTH). 26 km N. of Williams, Albany Highway, 18.xi.1967, *A. S. George 9231* (PERTH). Stanley Street, Glen Forest, 1.ix.1978, *J. W. Green 4894* (PERTH).

#### NOTES:

A distinctive species which is readily distinguished by the unifoliate leaves and the adaxially sulcate petioles with a pair of prominent apical stipellae. *T. hookeri*, the only other species in which the leaves are sometimes unifoliate, has crowded linear-terete to filiform leaves, long filiform pedicels, a different distributional range, and differs in several other significant ways.



Fig. 6. *Templetonia drummondii*. a—flowering specimen, x 1; b—unifoliate leaf showing stipules at base of petiole at point of attachment to stem and stipellae at apex, x 1½; c—adaxial view of petiole showing the conspicuous channel running down its length, the basal stipules and apical stipellae, x 4; d—abaxial view of petiole showing the points of articulation at the base of the petiole and the base of the leaf, the basal stipules and apical stipellae, x 4; e—side view of flower, x 3; f—calyx opened out (upper lobes on left), x 3; g—standard, x 3; h—wing petal, x 3; i—keel petal, x 3; j—fruiting twig, x 1; k—seed, hilar view, x 5. l—seed, side view, x 5. a—i from A. S. George 6770 (PERTH); j—l from A. S. George 9231 (PERTH).

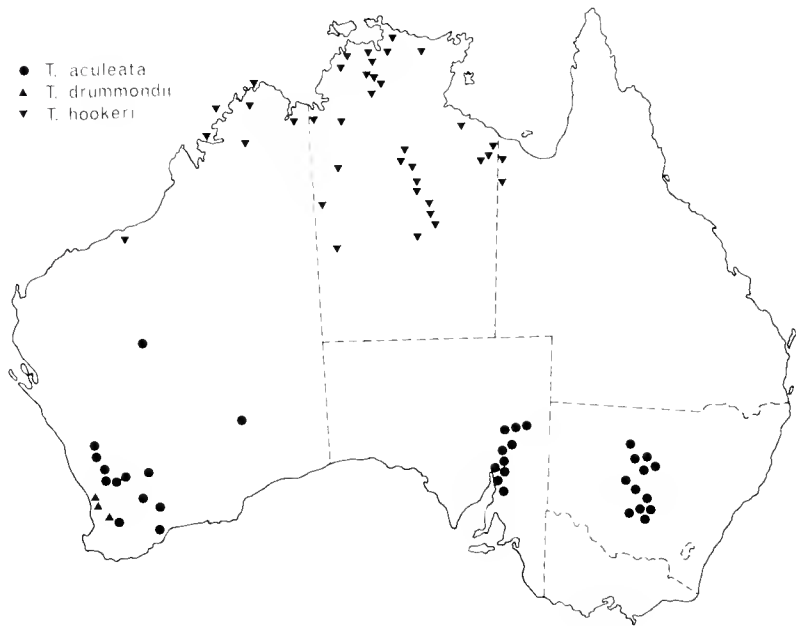


Fig. 7. The known distributions of *Templetonia aculeata*, *T. drummondii* and *T. hookeri*.

*T. drummondii* is in some respects superficially similar to *T. stenophylla* but the latter differs in having simple more or less sessile narrow-oblong, oblong or linear-oblong leaves, pods on a stipe which exceeds the calyx, and a different distribution.

7. ***Templetonia hookeri*** (F. Muell.) Benth., Fl. Austr. 2: 170 (1864). *Nematophyllum hookeri* F. Muell., Hook., J. Bot. & Kew Gard. Misc. 9: 20 (1857). Type: Northern Territory, Upper Victoria river and Sturt's Creek, F. Mueller (MEL 1516623!, here selected as **lectotype**).

Several-stemmed slender shrub up to 3 m high with smooth greyish-brown to greenish-yellow bark; branches greenish-yellow to yellowish-grey, terete, inconspicuously sulcate, glabrous to fairly densely appressed-pubescent, unarmed. *Stipules* inconspicuous, up to 1 mm long. *Leaves* linear-terete to filiform, 1-foliolate or digitately to pinnately 3-5-foliolate, 1.8-11.5 cm long, usually rather crowded, with a pair of inconspicuous stipellae up to 0.6 mm long at the point of attachment of the leaflets, glabrous to sparingly pubescent, with a mass of fine dark glandular processes in the axils; leaflets linear-terete to filiform and typically with a short recurved tip, articulated at the point of attachment to the petiole or rachis. *Flowers* usually 1 per axil, pale lemon-yellow, on glabrous to sparingly pubescent filiform pedicels 2-2.5 cm long (up to 4 cm long in fruit), the pedicels with a pair of ovate papery bracteoles up to 1.5 mm long towards the apex, the bracteoles glabrous except for a fringe of apical cilia or sparingly pubescent throughout. *Calyx* with 4 acuminate lobes, the upper lobe up to 10.5 mm long (up to 14 mm in fruit) and broader than the others, the two laterals up to 8.5 mm long, and the lowest up to 12 mm long (18 mm in fruit), the lobes longer than the tube, glabrous to sparingly pubescent. *Standard* orbicular, up to 18 mm long including the claw, 9-11 mm wide, emarginate apically; wings up to 12 mm long including a claw up to 2 mm long, up to 4.5 mm wide, auricled; keel petals up to 16 mm long including a claw up to 2.5 mm long, up to 6.5 mm wide, auricled. *Stamens* up to 16 mm long. *Ovary* up to 8 mm long, on a stipe up to 3.5 mm long, glabrous. *Pods* oblong, sometimes obliquely so especially when young, 2.4-3.7 x 0.95-1.3 cm, narrowed to an acute beak apically, mostly 3-4-seeded, valves yellowish-green when young but ripening to shiny brown,

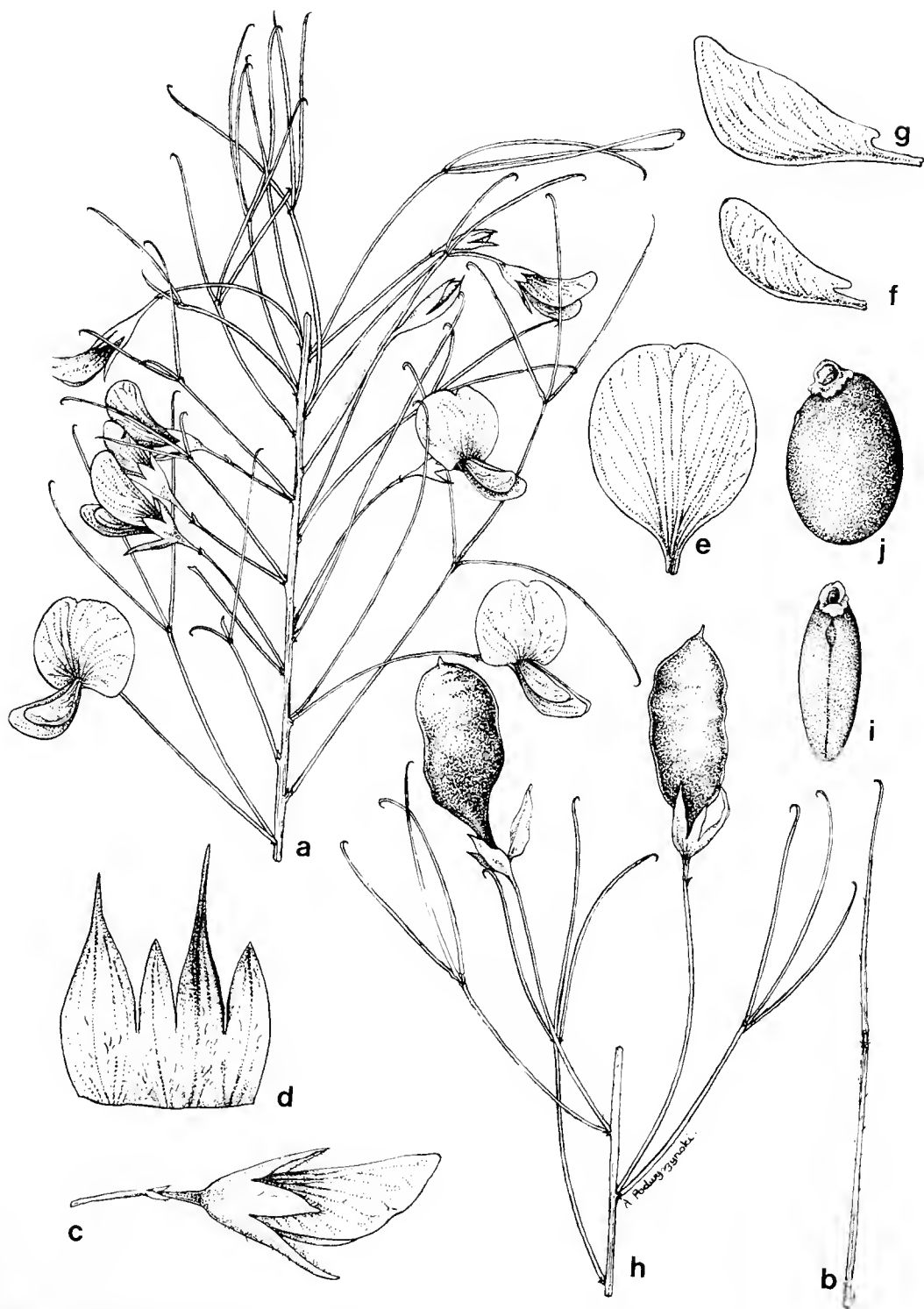


Fig. 8. *Templetonia hookeri*. a—flowering twig, x 1; b—unifoliate leaf, x 1½; c—side view of flower, x 2; d—calyx opened out (upper lobe on left), x 3; e—standard, x 2; f—wing petal, x 2; g—keel petal, x 2; h—fruiting twig, x 1; i—seed, hilar view, x 4; j—seed, side view, x 4. a—c, h, from I. B. Wilson 394 (NT 20236); d—g from J. H. Calaby AE 364 (NT 38803); i, j from N. M. Henry 848 (NT 38778).



coriaceous, convex, glabrous. *Seeds* elliptic, 4.5-6.5 x 3-4 mm and up to 2.5 mm thick, dark brown, the small hilum surrounded by a collar-like aril with a raised lateral lip (Fig. 8).

*T. hookeri* occurs in northern Western Australia (including some of the off-shore islands), the central and northern areas of the Northern Territory and the north-western corner of Queensland where it is found most frequently on sandstone or quartzite outcrops or in laterite or gravelly soils along creeks (Fig. 7).

#### REPRESENTATIVE SPECIMENS EXAMINED:

*Western Australia*—Warralong, 20.v.1941, *N. T. Burbidge* 813 (PERTH). Augustus Island, Bonaparte Archipelago, 16.v.1972, *P. G. Wilson* 10812 (PERTH). Wood Island (North), 12.vii.1973, *P. G. Wilson* 11522 (PERTH).

*Northern Territory*—± 70 km NE. of Maranboy Police Station, 6.iii.1965, *Lazarides & Adams* 112 (BRI 157643, CANB 151794, MEL 1517029, NT 39498). 94 km N. of Tennant Creek, 25.xi.1970, *J. R. Maconochie* (NT 29059). 1.6 km W. of South Alligator crossing, El Sharana, 16.1.1973, *J. H. Calaby* AE 364 (BRI 16 3878, CANB 237655, NT 38803).

*Queensland*—East Branch, Settlement Creek, viii.1922, *L. Brass* 173 (BRI 243361). 16 km SSE. of Morestone, 28.x.1948, *R. A. Perry* 1054 (BRI 243363, NT 20238). Burke Distr., 26 km from Gunpowder on the Quamby Road, 23.x.1972, *G. W. Althofer* 297 (BRI 149772).

#### NOTES:

A distinctive species which is readily distinguished by the linear-terete to filiform 1-foliate or digitately to pinnately 3-5-foliate leaves and the long filiform pedicels. In addition, *T. hookeri* has a more northern distribution than the other species in the genus. *T. drummondii* is the only other species with unifoliate leaves but the two species cannot be confused.

8. *Templetonia aculeata* (F. Muell.) Benth., Fl. Austr. 2: 170 (1864); Moore & Betche, Handb. Fl. N.S.W. 143 (1893); Diels & Pritzel, Bot. Jahrb. 35: 265 (1904); J. M. Black, Fl. S. Austr. ed. 2: 446 (1948). *Bossiaea aculeata* F. Muell., Fragm. Phyt. Austr. 2 (15): 120 (1861). Type: Western Australia, near the Culjong River, A. Oldfield (MEL 20339, holo.! There is no type material of *T. aculeata* at Kew or the British Museum (Natural History)).

Many-stemmed low subshrub or shrub up to 0.4 m high with simple or branched stems, the stems green or yellowish, ± terete, inconspicuously or conspicuously ridged, sometimes somewhat zig-zagging, usually sparingly to densely pubescent with appressed or somewhat spreading hairs especially between the ridges but sometimes ± glabrous. *Stipules* spinescent, in pairs, up to 1 cm long, spreading or recurved. *Leaves* present or absent, simple, the lower ones obovate or obovate-oblong and the upper linear-oblong, 0.5-3 x 0.1-0.8 cm, pungent-pointed, usually sparingly to densely pubescent especially on the upper surface but sometimes glabrous, sometimes with conspicuous venation on the lower surface, with a mass of fine dark glandular processes in the axils. *Flowers* 1 or 2 per axil, on pedicels up to 5 mm long, the pedicels glabrous to sparingly pubescent, with a very small inconspicuous basal bract with fimbriate margins and a pair of ovate bracteoles up to 3.5 x 3.5 mm at about the middle of the pedicel which often overlap the base of the calyx; bracteoles glabrous to densely pubescent outside and within, with marginal cilia apically. *Calyx* up to 9 mm long, the 2 upper lobes united and slightly broader than the others, the lowest longest, the lobes shorter than the tube, sparingly to densely pubescent outside, the apices of the lobes with marginal cilia and often with a purplish tinge. *Standard* orbicular, 12-18 mm long including a claw up to 3 mm long, 10-13 mm wide, slightly emarginate apically, apparently usually yellow inside with a deep yellow basal horseshoe-shaped throat surrounded by a dark red or purplish fringe and with a dark red or purplish midvein extending to the emarginate apex, dark red or purplish outside with a yellow border; wings up to 14 mm long including a claw up to 2 mm long, up to 4.5 mm wide, auricled, mostly dark red or purplish throughout or yellow towards the apex; keel petals lightly united, up to 14 mm long including a claw up to 3.5 mm long, up to 5 mm wide, auricled, dark red or purplish. *Stamens* up to 14 mm long. *Ovary* shortly stipitate, glabrous. *Pods* ob-

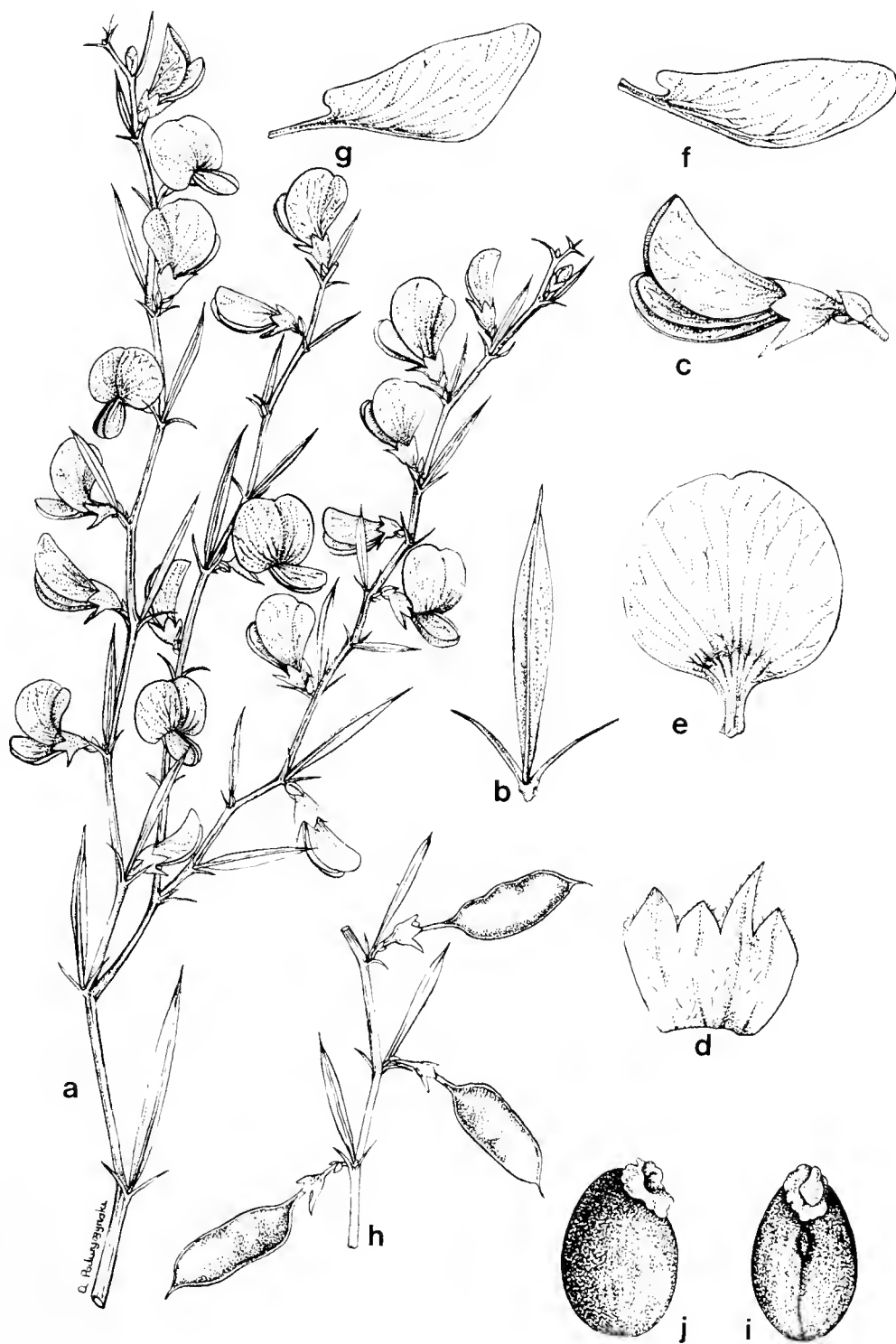


Fig. 9. *Templetonia aculeata*. a—flowering twig, x 1; b—leaf and paired stipular spines, x 2; c—side view of flower, x 2; d—calyx opened out (upper lobe on left), x 3; e—standard, x 3; f—wing petal, x 3; g—keel petal, x 3; h—fruiting twig, x 1; i—seed, hilar view, x 7; j—seed, side view, x 7. a—g from R. Hill 1411 (AD 96532156); h—j from M. D. Crisp 1573 (AD 97709767).

liquely oblong or oblong-elliptic, 1.5-2 x 0.6-0.75 cm, on a stipe up to 0.7 cm long which exceeds the calyx, narrowed to an acute beak apically, mostly 3-4-seeded; valves coriaceous, scarcely raised, glabrous. *Seeds* 2.6-3.9 x 1.4-2.5 mm, separated by transverse frass-like partitions, the small hilum surrounded by a collar-like aril with a raised lateral lip (Fig. 9).

*T. aculeata* has a disjunct distribution in Western Australia, South Australia and New South Wales, the populations in each State being widely separated from those in the adjacent State (Fig. 7). The species is usually found in deep sandy soil or rocky areas.

#### REPRESENTATIVE SPECIMENS EXAMINED:

*Western Australia*—78 km E. of Jerramungup, 24.viii.1963, *V. E. Sands* 638.16.18 (PERTH). Coolgardie Distr., 32 km E. of Lake King township, 16.ix.1964, *P. G. Wilson* 3243 (AD 96526258, PERTH). Helms Distr.,  $\pm$  35 km W. of Plumridge Lakes, 8.5 km WNW. of Salt Creek airstrip, 15.ix.1979, *M. D. Crisp* 5837, *J. Taylor & R. Jackson* (MEL 564747).

*South Australia*—Northern Flinders Range, Arcoona Bluff Range N. of Arcoona Pound,  $\pm$  9 km E. of Owieandana Hut, 15.ix.1956, *Hj. Eichler* 12615 (AD 95709111). Southern Flinders Range, Rail Reserve between Wirrabara and Yandiah, 5.xi.1969, *B. Copley* 2485 (AD 97009188).  $\pm$  6 km W. of Gladstone, 10.ix.1970, *B. Copley* 3072 (AD 97119340).

*New South Wales*—3.2 km E. of Matakana, 16.ix.1972, *G. M. Cunningham* 433 & *P. L. Milthorpe* (NSW 127988). 37 km SW. of Nyngan on Bobadah Rd., 30.viii.1974, *G. M. Cunningham* 2745 & *P. L. Milthorpe* (NSW 143388). Western plains, Garoolgan turn-off, 22 km E. of Rankins Springs towards West Wyalong, 19.xi.1975, *M. D. Crisp* 1573 (AD 97709767, CBG 66548).

#### NOTES:

There is a sheet of *T. aculeata* in the Western Australian Herbarium, Perth, with a printed "National Herbarium of Victoria, Melbourne" label on which the following is written: "Templetonia aculeata Benth. Near the Culjong W.A. (Old.)". The PERTH sheet consists of five separate twigs, two of which are sterile, and one detached flower and the remnants of another. The other three twigs have floral remnants attached. As the PERTH material appears to consist of a mixed gathering and does not match the holotype collection in MEL, it is not considered to be part of the type collection.

Flower colour in *T. aculeata* requires clarification. Black (1948) described the standard as "white and purple" and the keel as "dark-purple", while the flowers have been variously described by collectors as yellow and red, dark red and yellow, red, brown and yellow, and brown. The flower colour provided in the above description was taken from a colour transparency accompanying *M. D. Crisp* 5837 et al. It is not clear whether flower colour varies to the extent suggested by Black and by other collectors.

*T. aculeata* is a very distinctive species which is readily distinguished from all others in the genus by the spinescent stipules and the pungent leaf apices.

Amongst the material previously referred to *T. aculeata* is a sterile leafless specimen, C. W. E. Moore 5721 (BRI 174670, CANB 209396, NSW 143393) from "Tundulya",  $\pm$  40 km S.E. of Louth, New South Wales. The specimen bears little resemblance to typical *T. aculeata* but its identity is not known.

**9. *Templetonia egena*** (F. Muell.) Benth., Fl. Austr. 2: 170 (1864); Moore & Betche, Handb. Fl. N.S.W. 144 (1893); J. M. Black, Fl. S. Austr. ed. 2: 446, fig. 612 (1948); Willis, Handb. Pl. Vict. 2: 281 (1973). *Daviesia egena* F. Muell., Trans. & Proc. Victorian Inst. Advancem. Sci. 1854-55: 118 (1855). *Bossiaea egena* (F. Muell.) F. Muell., Hook. J. Bot. & Kew Gard. Misc. 8: 43 (1856); Fragm. Phyt. Austr. 3: 94 (1862). Type: South Australia, "Murray-scrub Morundam versus", *F. Mueller*, Feb. 1851 (MEL 20345 here selected as **lectotype!**).

Many-stemmed leafless glabrous shrub up to 3 m high, often as wide as or wider than high; branches green or yellowish,  $\pm$  terete, usually distinctly ridged, unarmed. *Stipules* absent. *Leaves* reduced to minute scales up to 1 mm long, with a mass of fine dark glandular processes in the axils. *Flowers* in lax terminal racemes, mostly 1 or 2 per axil, on glabrous pedicels up to 1.75 mm long which have a pair of ovate



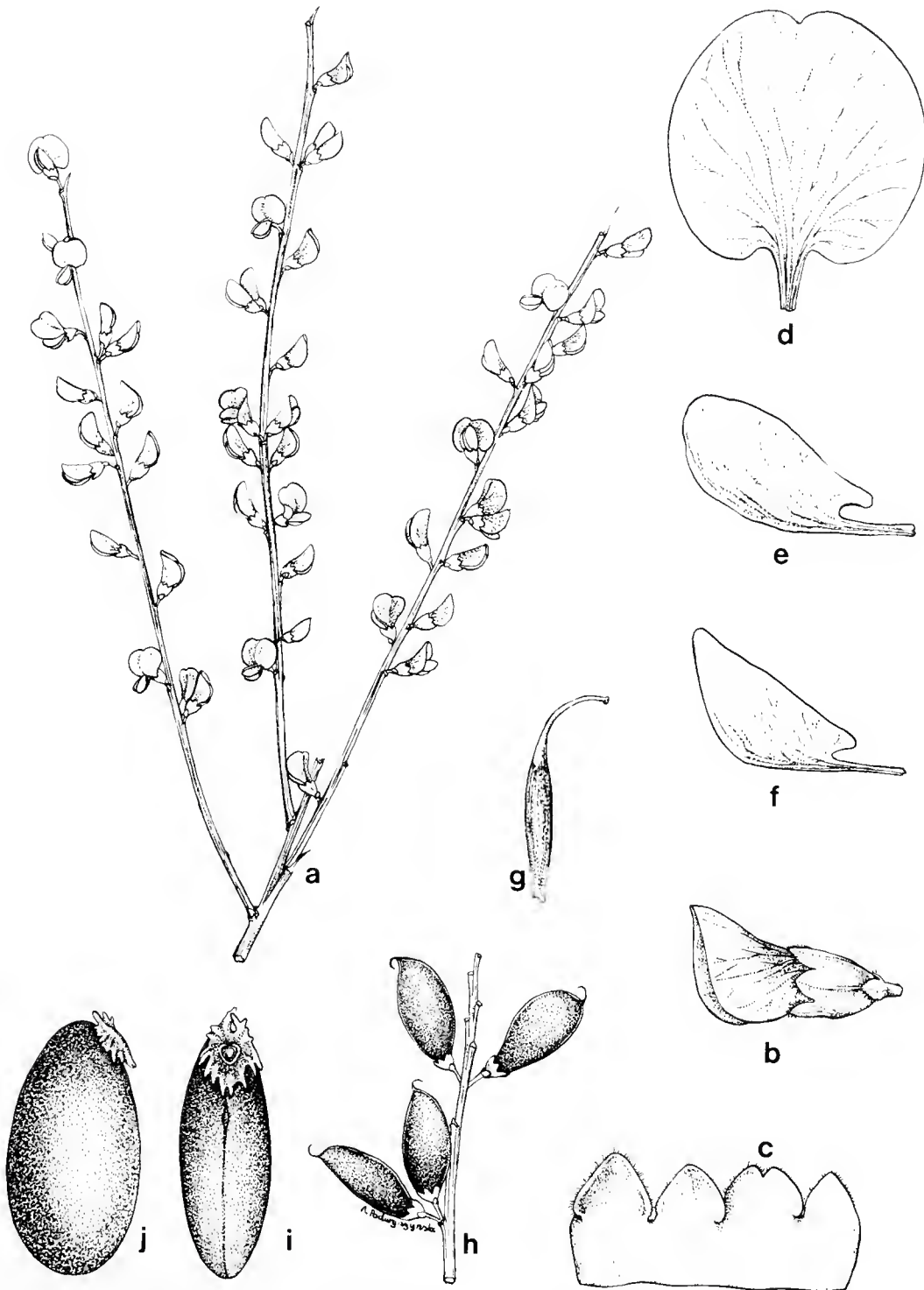


Fig. 10. *Templetonia egea*. a—flowering twig, x 1; b—side view of flower, x 4; c—calyx opened out (lower lobe on left), x 6; d—standard, x 6; e—wing petal, x 6; f—keel petal, x 6; g—gynoecium showing slender style and small terminal stigma, x 4; h—fruiting twig, x 1; i—seed, hilar view showing frilly margin to aril, x 4; j—seed, side view, x 4. a—g from N. N. Donner 3715 (MEL 1503343); h from A. C. Beauglehole 57011 (MEL 1507639); i, j from H. U. Stauffer and P. G. Wilson 5424 (MEL 564627).

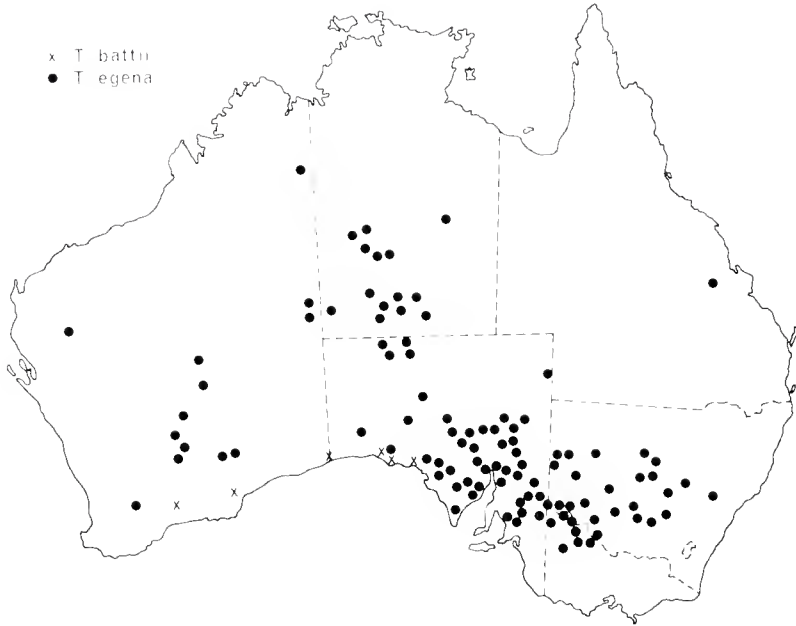


Fig. 11. The known distributions of *Templetonia battii* and *T. egena*.

bracteoles up to 2 mm long near the apex, the bracteoles glabrous except for marginal cilia. *Calyx* up to 4 mm long, the lowest lobe longer than the others, the lobes shorter than the tube, glabrous except for a fringe of hairs on the apices of the lobes. *Standard* orbicular, 5.5-7 mm long including a claw up to 2 mm long, 5-7 mm wide, emarginate apically, with a dark yellow horseshoe shaped throat surrounded by a purplish-brown fringe, pale yellow on margins, deep purplish outside on margins when young but fading to paler purplish-brown and the margins becoming yellow, the purplish-brown zone surrounding a darker yellow inner area; wings 5-7 mm long including a claw up to 2 mm long, 2-2.5 mm wide, auricled, purplish-brown; keel petals lightly united, 4.5-6.5 mm long including a claw up to 2 mm long, 1.8-2.5 mm wide, auricled. *Stamens* up to 7 mm long. *Ovary* ± sessile, glabrous; style slender, curved, with a small terminal stigma. Pods narrowly oblong-elliptic, often obliquely so, 1.3-2.2(2.6) x 0.6-1 cm, sessile, narrowed to an acute beak apically, 1-seeded, valves coriaceous, convex, glabrous, deep brown when mature. *Seeds* elliptic, 7.5-10(13.5) x 3.5-4.5(5.5) x 2.5-3.25 mm, compressed, light brown, the small hilum surrounded by a collar-like aril with a frilly margin (Fig. 10).

*T. egena* occurs in each mainland state and is the most widely distributed species in the genus (Fig. 11). Several apparent discontinuities exist in its distribution, the largest being between the solitary Queensland record and the nearest populations in New South Wales. *T. egena* occurs most frequently in deep sandy soil or laterite.

#### REPRESENTATIVE SPECIMENS EXAMINED:

*Western Australia*—Gordon Downs, 13.ix.1950, *R. D. Royce* 3332 (PERTH). Bilgarrie Cutarrie Bore, ± 215 km N. of Laverton, 28.viii.1968, *P. G. Wilson* 7408 (PERTH). 14 km N. along Docker River road from Giles—Mulga Park road, 21.vii.1974, *A. S. George* 12051 (PERTH).

*Northern Territory*—73 km W. of Finke Town, 14.x.1957, *G.M. Chippendale* (BRI 7829, MEL 564630, NSW 44524, NT 3972). 11 km S. of Lasseters Cave, Petermann Ranges, 3.xi.1970, *C. Dunlop* 2028 (NT 28676). 24 km E. of Curtin Springs H.S., 23.viii.1973, *J. R. Maconochie* 1816 (NT 40570).

*South Australia*—Flinders Range, 14.4 km SW. of Carrieton, 27.xi.1963, *H. U. Stauffer & P. G. Wilson* 5424 (AD 96827257, MEL 564627, NSW 99360). Lake Torrens Basin, Roxby Downs Station, ± 3 km E. of homestead, ± 100 km NNW. of Woomera, 19.viii.1971, *B. Lay* 394 (AD 97149224). ± 32 km S. of Yunta, 2.x.1971, *N. N. Donner* 3715 (AD 97206168, MEL 1503343).

Queensland—Leichhardt Distr., 24 km SSE. of Blackwater Township, 6.ix.1961, *M. Lazarides & R. Story* 56 (CANB 111976, MEL 1507638, NSW 1434032).

New South Wales—Broken Hill, xii.1918, *E. C. Andrews s.n.* (NSW 44556). Moulamein, 9.x.1970, *W. E. Mulham* (NSW 114018). "Urunda", Hermitdale, 26.ix.1977, *D. F. Thompson* 1870 (NSW 143394).

Victoria—Robinvale Distr., Wemen, viii.1960, *A. R. Begg s.n.* (MEL 564659). Hattah Lakes National Park, Hattah area, 10.ix.1960, *A. C. Beauglehole* 39180 (MEL 564621). Meringur Bushland Reserve, 15 km E. of Morkalla, 31.x.1977, *A. C. Beauglehole* 57011 (MEL 1507639).

#### NOTES:

*D. E. Symon* 1115 (ADW 23586, NT 20242) from the S.W. corner of Commonwealth Hill Station,  $\pm$  38.4 km NW. of Wynbring railway station, South Australia, is an unusually robust specimen of *T. egena* with large pods and seeds. The pods are slightly longer than usual (2.2-2.5 x 0.9-0.95 cm) and the seeds are the largest seen being up to 13.5 x 5.5 x 3.25 mm. Other isolated specimens with large pods similar to those of *Symon* 1115 occur infrequently throughout the range of the species, for example *D. J. Nelson* 98 (NSW 143401, NT 8489) from 14 km S. of Mount Wedge H.S., Northern Territory and *A. Morris* (NSW 44555) from Broken Hill, New South Wales, the two latter specimens having immature seeds.

A. R. Begg, the collector of a specimen (MEL 564659) from Wemen, Robinvale Distr., Victoria, comments that *T. egena* has "a peculiar scent when in flower (almost a perfume) which attracts many insects and moths, in particular one of the latter which is a brilliant iridescent blue."

Mueller (1892) reported that a woman from Darling River died one hour after drinking a cupful of an infusion of *T. egena* although, as indicated by Hurst (1942), this does not necessarily constitute proof of the poisonous properties of the species as the death may have resulted from the ailment which led to the infusion being taken. Everist (1974) makes no mention of *T. egena* being poisonous to humans or animals.

*T. egena* is most closely related to *T. battii* which differs, however, in having shorter more rigid intricately branched pungent-tipped branches, shorter inflorescences, short thickened styles with larger stigmas than in *T. egena*, and smaller seed in which the collar-like aril has a small slightly raised lateral lip and more deeply incised margins. The  $\pm$  terete slightly ridged stems readily distinguish *T. egena* from *T. sulcata* in which the stems are distinctly flattened.

**10. *Templetonia battii*** F. Muell., Chem. and Drugg. Australas. 2, 2: 31 (1 Feb. 1887); Bot. Centralbl. 30, 6: 180 (1887); J. M. Black, Trans. & Proc. Roy. Soc. S. Austr. 43: 33 (1919); J. M. Black, Fl. S. Austr. ed. 2: 446 (1948). *Bossiaea battii* (F. Muell.) R. Tate, Fl. Extra-trop. S. Austr. 65 (1890). Syntypes: Western Australia, Eucla, *J. D. Batt* (MEL 564735!, MEL 564736!).

Several-stemmed leafless glabrous divaricate shrub up to 1.4 m high, sometimes as wide as or wider than high; branches rigid, intricately branched,  $\pm$  terete, distinctly but inconspicuously longitudinally ridged, terminating in pungent points. *Stipules* absent. *Leaves* reduced to minute scales up to 1 mm long, with a mass of fine dark glandular processes in the axils. *Flowers* in short terminal racemes, 1 or 2 per axil, yellow and brown, on short glabrous pedicels 0.5-1.3 mm long, the pedicels with a pair of ovate bracteoles up to 1.5 mm long and 1.8 mm wide from near the middle to towards the apex, the bracteoles glabrous throughout or margins of lobes minutely ciliate, overlapping the base of the calyx. *Calyx* up to 3.7 mm long, the lowest lobe longer than the others, the lobes shorter than the tube, glabrous throughout or apices of lobes minutely ciliate. *Standard* slightly oblate, 5.5-6.5 mm long including a claw up to 1.5 mm long, 6-7 mm wide, emarginate apically; wings 4.8-5.5 mm long including a claw up to 2 mm long, up to 2.5 mm wide, auricled and infolded basally, usually slightly longer than the keel petals; keel petals lightly united, 4.5-5 mm long including a claw up to 1.6 mm long, 1.8-2.2 mm wide, auricled. *Stamens* up to 4.7 mm long. *Ovary*  $\pm$  sessile, glabrous, up to 2.5 mm long; style short, thickened, curved, with a large terminal stigma. *Pods* narrowly oblong-elliptic, 1.2-1.5 x 0.5-0.65 cm, sessile, narrowed to an acute beak apically, 1-seeded,

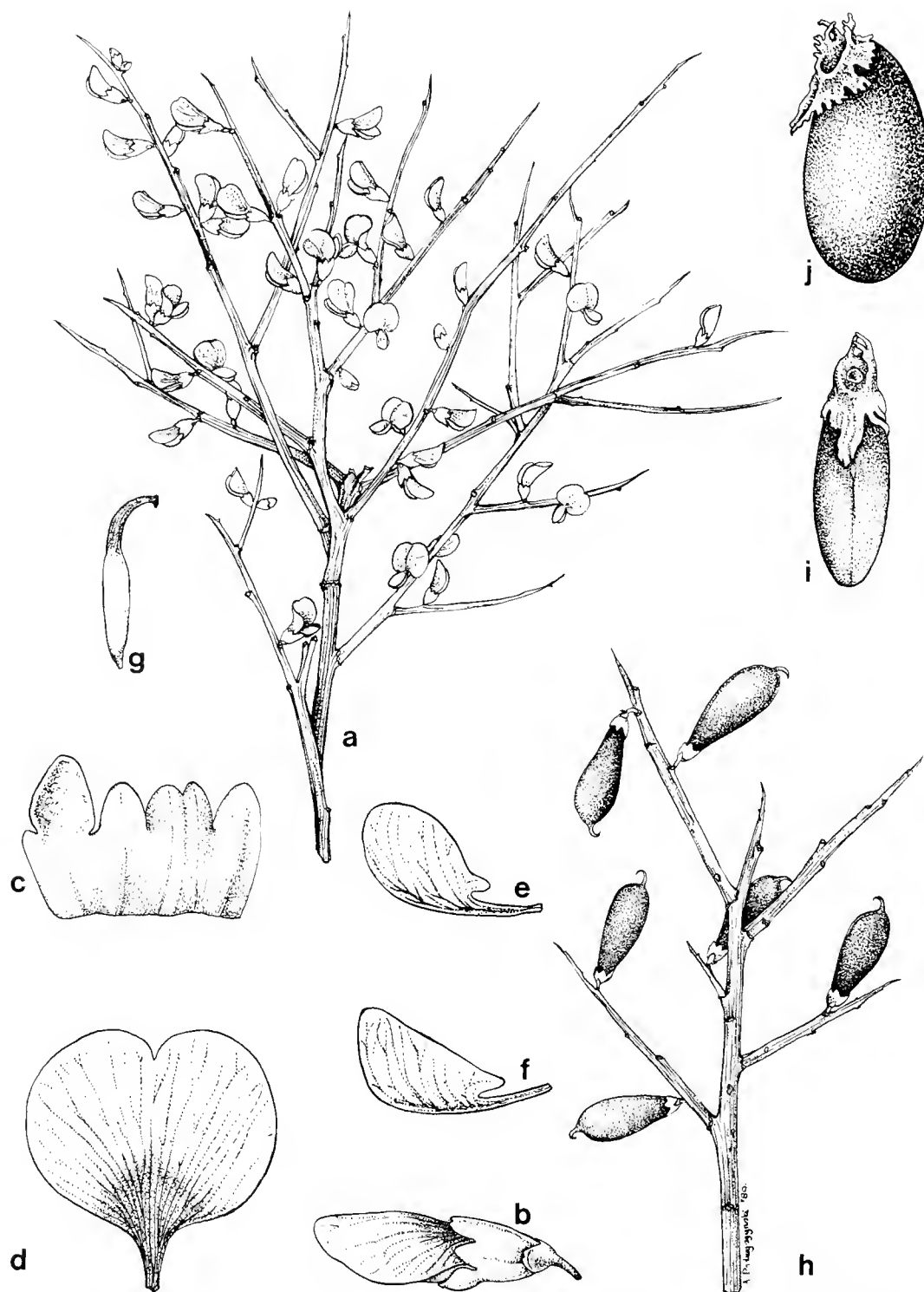


Fig. 12. *Templetonia battii*. a—flowering twig, x 1; b—side view of flower, x 4; c—calyx opened out (lower lobe on left), x 6; d—standard, x 6; e—wing petal, x 6; f—keel petal, x 6; g—gynoecium showing short thick style and large terminal stigma, x 4; h—fruiting twig, x 1; i—seed, hilar view, x 6; j—seed, side view, x 6. a, b from J. B. Cleland s.n. (AD 966080567); c—h from R. H. Ashby s.n. (AD 97551010); i, j from J. D. Batt (MEL 564736).



valves coriaceous, convex, glabrous, deep brown when mature. *Seeds* elliptic, 4.8-5 x 2.5-2.8 mm and  $\pm$  2 mm thick, compressed, the small hilum surrounded by a collar-like aril with a small slightly raised lateral lip, the margins frilly and more deeply incised than in *T. egena* (Fig. 12).

*T. battii* is a rare species with a fairly restricted distribution between Lake King in Western Australia and Denial Bay, South Australia (Fig. 11), and is usually found growing in limestone.

#### REPRESENTATIVE SPECIMENS EXAMINED:

*Western Australia*—Eucla, J. D. Batt (MEL 564730). 3 km SE. of Hatters Hill,  $\pm$  41 km NE. of Lake King, 9.viii.1980, K. Newbey 5466 (PERTH). 20 km WSW. of Ponier Rock,  $\pm$  78 km S. of Balladonia Motel, Eyre Highway, 14.ix.1980, K. Newbey 7360 (PERTH).

*South Australia*—Colona Homestead, 288 km E. of Eucla, 27.viii.1947, J. H. Willis (MEL 564725, PERTH). Western Eyre Peninsula, Koonibba,  $\pm$  25 km NE. of Ceduna, 17.ix.1957, J. B. Cleland s.n. (AD 966080567).  $\pm$  1 km N. of Denial Bay, 20 km W. of Ceduna, 10.ix.1960, P. G. Wilson 1534 (AD 96134007). Denial Bay, 20 km inland from Ceduna, 26.vii.1969, B. Copley 2611 (AD 96937251). Near Nundroo Well, 31°45'S, 132°12'E, 15.xi.1975, R. H. Ashby s.n. (AD 97551010).

#### NOTES:

There are three sheets of *T. battii* collected by J. D. Batt in the National Herbarium of Victoria although none is accompanied by a label in Batt's hand. MEL 564736 is a fruiting specimen with "*Templetonia battii* F. v. M." written in Mueller's hand and "Eucla, W. Aust. Jan. 1887 J. D. Batt" in another hand. MEL 564735 is a flowering specimen accompanied by a handwritten description of the flowers in Mueller's hand, while MEL 564730 is a fruiting specimen with "*Templetonia*" written in Mueller's hand and a pencilled label which reads "J. D. Batt West Australia" in another hand.

Mueller's description of *T. battii*, in Chem. and Drugg. Australas. 2, 2:31 (1887), was based on flowering and fruiting material so it is clear that at least two of the three MEL sheets are syntypes. Mueller described the pods in the protologue as "dark-greenish" which suggests that MEL 564730 is not a syntype as the pods in this specimen are pale yellowish brown in contrast to the dark pods in MEL 564736. J. D. Batt resided in the Eucla district for at least a decade (1886-1896) and would have had ample opportunity to collect further material subsequent to the publication of the species (Willis, 1959). There is no type material of *T. battii* at Kew or the British Museum (Natural History).

*T. Battii* is most closely related to the widespread *T. egena* and the differences between the two are discussed under the latter. As in the case of *T. egena*, the  $\pm$  terete stems readily distinguish *T. battii* from *T. sulcata* in which the stems are distinctly flattened.

**11. *Templetonia sulcata*** (Meissn.) Benth., Fl. Austr. 2:171 (1864); Moore & Betche, Handb. Fl. N.S.W. 144 (1893); J. M. Black, Fl. S. Austr. ed. 2:446 (1948); Willis, Handb. Pl. Vict. 2:281 (1973). *Bossiaea sulcata* Meissn. in Pl. Preiss. 1:81 (1844-45). Type: Western Australia, Avon River, York, Preiss 1028 (K!, MEL!). Possible synonym: *Bossiaea rossii* F. Muell. Fragm. Phyt. Austr. 3:94 (1862). See discussion and lectotypification under notes below.

Many-stemmed leafless shrub 0.5-3.2 m high with numerous divaricate flattened branches, the branches green or yellowish, distinctly flattened, 2.5-6 mm wide, faintly or distinctly longitudinally striate, the margins notched at the nodes, often terminating in a short spine, glabrous or occasionally sparingly pubescent or puberulous. *Stipules* inconspicuous. *Leaves* reduced to minute scales up to 1 mm long, with a mass of fine dark glandular processes in the axils. *Flowers* mostly 1 or 2 per axil, on glabrous pedicels up to 2 mm long, the pedicels with a pair of ovate papery brown bracteoles 1.5-2.5 x 1.6-2.1 mm which overlap the base of the calyx, the bracteoles strongly convex outside, concave within, glabrous or with apical marginal cilia. *Calyx* up to 4.3 mm long, the lowest lobe often slightly longer than the others, the lobes  $\pm$  as long as or shorter than the tube, glabrous outside except

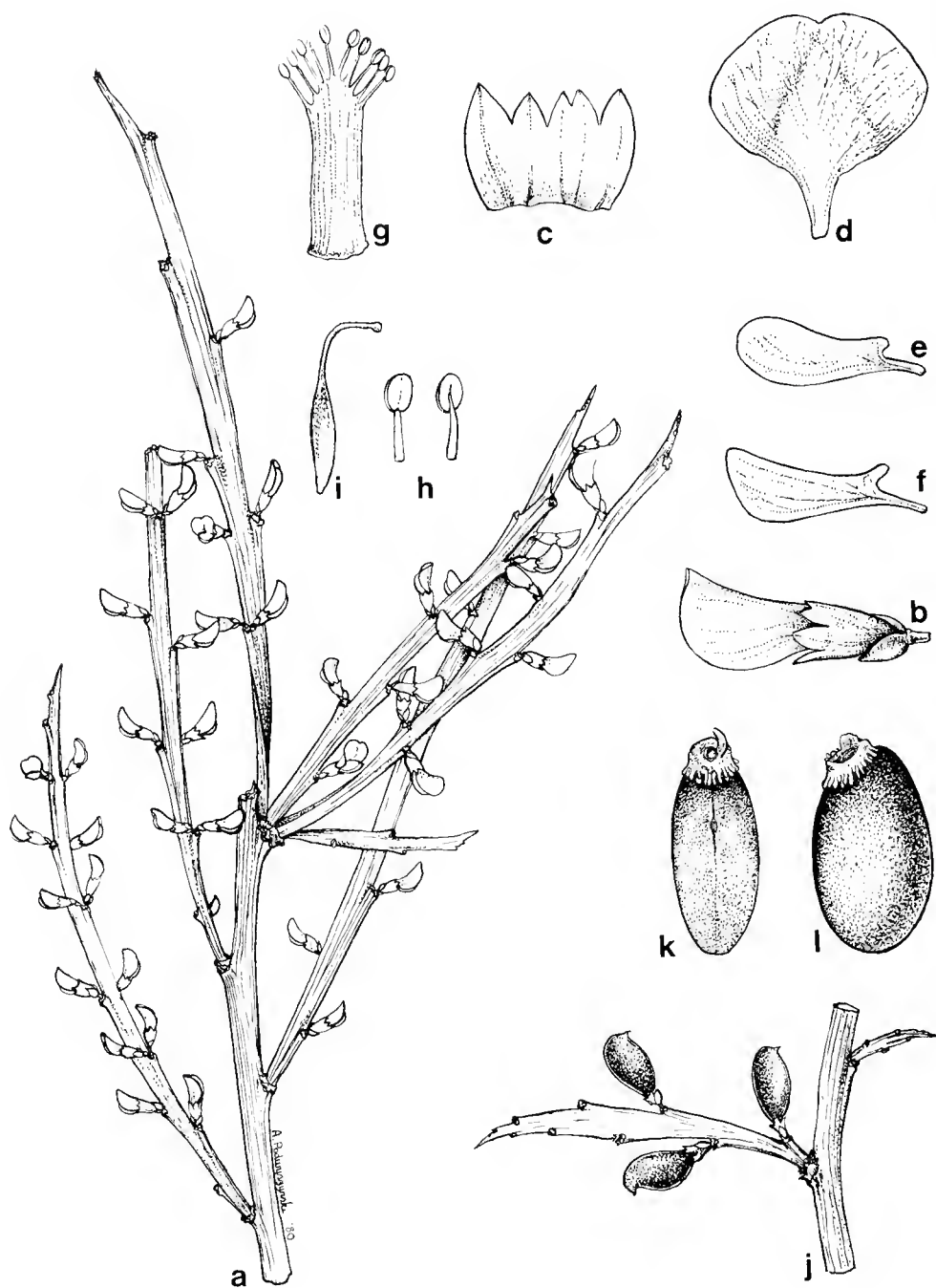


Fig. 13. *Templetonia sulcata*. a—flowering twig, x 1; b—side view of flower, x 4; c—calyx opened out (lower lobe on left), x 5; d—standard, x 5; e—wing petal, x 5; f—keel petal, x 5; g—staminal tube opened out, x 5; h—rear view of anthers showing attachment of filaments, x 10; i—gynoecium, x 5; j—fruiting twig, x 1; k—seed, hilar view, x 6; l—seed, side view, x 6. a—i from M. G. Corrick 6223 and B. A. Fuhrer (MEL 1515223); j from R. D. Royce 10168 (PERTH); k, l from Miss Cronin (MEL 92113).



Fig. 14. The known distribution of *Templetonia sulcata*.

for a fringe of hairs on the apices of the lobes, often pubescent within. *Standard* oblate, 5.5-7.5 mm long including a claw up to 1.5 mm long, 5.5-6.5 mm wide, emarginate apically, yellow inside on the margins with a deep yellow basal horseshoe-shaped throat surrounded by a purplish fringe, purplish-brown outside except for yellow towards the margins; wings up to 5.5 mm long including a claw up to 2 mm long, up to 2.3 mm wide, auricled, purplish-brown outside except for a faint yellowish tinge towards the margins; keel petals lightly united, up to 5 mm long including a claw up to 2 mm long, up to 2.3 mm wide, auricled. *Stamens* up to 4.5 mm long. *Ovary* subsessile or very shortly stipitate, 2-6-ovulate, glabrous. *Pods* obliquely obovate or elliptic, narrowed to an acute lateral apical beak, of two distinct sizes, 0.75-2.5 cm long x 0.4-1.4 cm wide x 0.2-0.8 cm thick, sessile or very shortly stipitate, 1-2-seeded, valves coriaceous, convex, dark brown, glabrous. *Seeds* elliptic, of two distinct sizes, 4-14.5 x 2.2-8.5 mm, the small hilum surrounded by a collar-like aril (Fig. 13).

The plants currently referred to *T. sulcata* are widely distributed in south-western New South Wales, north-western Victoria, south-central and south-eastern South Australia and south-western Western Australia, although the West Australian and South Australian populations are separated by a large geographical discontinuity (Fig. 14).

#### NOTES:

In New South Wales, Victoria and South Australia the plants are relatively uniform small to medium sized shrubs having flowers with conspicuous brown scarious bracteoles up to 2.5 mm long which are sometimes almost as long as the calyx-tube, calyces typically with 4 acute lobes although sometimes the upper lobe is slightly emarginate or dentate apically, small pods 0.75-1.8 x 0.4-0.75 cm and seeds 4-5.5 x 2.2-2.7 mm in which the small hilum is surrounded by a collar-like, frilly-margined aril with a raised lateral lip. However, in Western Australia the material traditionally referred to *T. sulcata* embraces two extremely closely related but different taxa which can only be distinguished with certainty when fruiting material is available. In addition to the small-podded taxon found in the eastern States, a large-podded taxon occurs which differs in having pods 1.4-2.5 x 0.95-1.4 cm and seeds 10-14.5 x 6-8.5 mm which lack the distinctive frilly-margin on the aril. While there is overlap in pod length between the two taxa, there is an absolute discontinuity in pod width and in seed size and there are significant differences in seed shape which suggest that each taxon should be accorded formal taxonomic recognition (Fig. 15). However, in the absence of fruiting material the two taxa in Western Australia are often extremely difficult to distinguish with any degree of confidence as reliance has to be placed on floral and vegetative differential tendencies which to date have not proved to be particularly satisfactory. The taxon with large pods appears to grow as a large shrub and there is a suggestion that it has slightly different ecological preferences to the small-podded taxon, at least in the Wongan Hills—Lake Moore



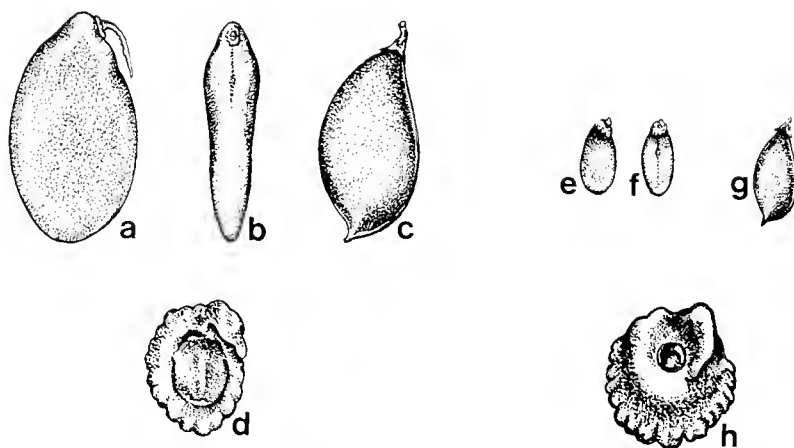


Fig. 15. *Templetonia sulcata*: comparison of pod and seed sizes of the big-podded (a–d) and small-podded (e–h) taxa. a—seed, side view, x 2; b—seed, hilar view, x 2; c—pod, x 1; d—hilar view of aril, x 9; e—seed, side view, x 2; f—seed, hilar view, x 2; g—pod, x 1; h—hilar view of aril, x 9. a–d from B. H. Smith (MEL 580089); e, f, h from Miss Cronin (MEL 92113); g from Miss Eaton (MEL 92110).

area (B. H. Smith, in litt.), but it is not known whether the alleged differences in habit and habitat apply throughout the distributional range of “*T. sulcata*” in Western Australia as most collectors regrettably make little or no mention in their notes of habit and habitat preferences. The flowers of the large-podded taxon have less conspicuous bracteoles which are much shorter than the calyx-tube, and the calyces typically have 5 short obtuse lobes and the ovaries often contain 4–6 ovules as opposed to the 2–4 usually found in the small-podded taxon. There do not appear to be any other significant floral or vegetative differences between the two taxa. While these apparent differences in floral characters do enable much of the flowering material in Western Australia to be sorted quite readily into two groups, the characters are inconsistent and a number of specimens cannot be placed with confidence, especially in the area where the distributions of the taxa overlap.

The known distribution of the two taxa in Western Australia is shown in Fig. 16. The large-podded taxon occurs largely north of a line which approximates very roughly with the Great Eastern Highway from Perth to Coolgardie, while the small-podded taxon occurs most frequently south of the Highway. However, the taxa occur sympatrically over a fairly large area and apparently each can be expected in an area bounded very approximately by Wongan Hills and Koorda in the north and by York and Coolgardie in the south. Many of the flowering specimens from within this area are difficult to place with confidence.

Unfortunately Preiss 1028, the type of *T. sulcata*, is a flowering specimen with very young pods collected near York from an area where both the small-podded and the large-podded taxa might reasonably be expected to occur. I have studied the type material repeatedly but at present am unable to match the type collection with flowering material of either the small-podded or the large-podded taxon with confidence. This inability to identify the type specimen as belonging to either the small-podded or the large-podded taxon with certainty places the correct application of the name *T. sulcata* in doubt. This is most unfortunate, but, until the identity of Preiss 1028 is established beyond doubt, it is proposed that the name *T. sulcata* continue to be used in a broad sense for both taxa even although this is, of course, unsatisfactory. However, little advantage is seen in rejecting *T. sulcata* as a name of uncertain application at this stage and supplanting it with another name which may in time itself have to be replaced.

Careful and detailed field studies are required in Western Australia in an endeavour to resolve this perplexing problem. Information is required on the varia-

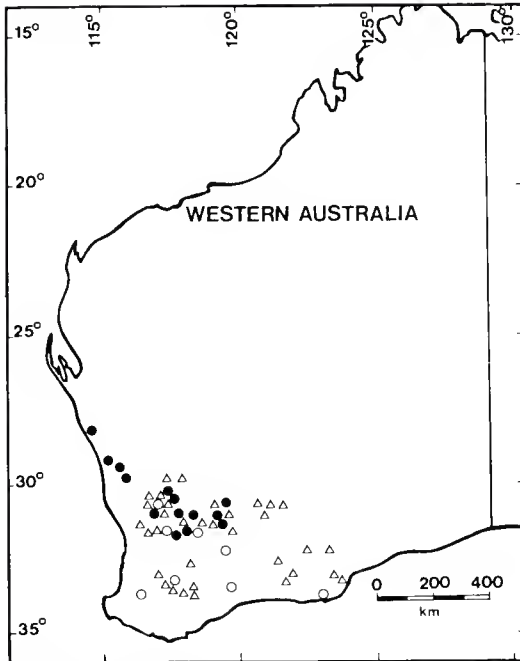


Fig. 16. The known distribution of *Templetonia sulcata* in Western Australia. ● — fruiting specimens with 'big' pods; ○ — fruiting specimens with 'small' pods; △ — sterile and flowering specimens and specimens with immature pods which cannot be referred to either the big-podded or small-podded taxon with certainty.

tion within and between populations, the flowering times, flower colour, habit and ecological preferences of the two taxa. If intensive field studies fail to establish the identity of Preiss 1028 then, and only then, is it considered appropriate to reject *T. sulcata* as a name of uncertain application.

If Preiss 1028 proves to be a flowering specimen of the small-podded taxon, then *T. sulcata* will be the correct name for this taxon and a new name will be required for the large-podded taxon. If, on the other hand, Preiss 1028 represents the large-podded taxon, then the name *T. sulcata* will have to be adopted for this taxon and the small-podded taxon will require another name. As it so happens, a name is available for the small-podded taxon, namely, *Bossiaea rossii* F. Muell., *Fragm. Phyt. Austr.* 3:94 (1862), although a new combination in *Templetonia* would be necessary.

Mueller based his description of *B. rossii* on specimens collected "In collibus arenosis et planitiebus apricis ad flumina Murray et Avoca, lacum Tyrrell versus". Curiously there are no specimens in the National Herbarium of Victoria bearing the name *Bossiaea rossii* in Mueller's hand, or in any other hand for that matter, and there is no type material of *B. rossii* at Kew or the British Museum (Natural History). There are in MEL only two specimens, each bearing a label in Mueller's hand, which could conceivably represent type material, namely, MEL 565687 bearing the information "*Templetonia sulcata* Benth., Murray" and MEL 20342 with the information "Frutex 1-2' alt. In planitiebus apricis ad fl. Avoca, 4 Dec. 53, F. Mueller." The label of MEL 565688 reads "*Bossiaea sulcata* Meissn., From the junction of the Murrumbidgee to Lake Lalbert" but this specimen was cited by Mueller, *Fragm. Phyt. Austr.* 3: 168 (1863), which suggests that it was collected subsequent to the publication of the protologue of *B. rossii* and this, coupled with the fact that the locality does not accord with the localities cited in the protologue, makes it unlikely that the specimen is a syntype. MEL 20342 and MEL 565687 are regarded as syn-

types of *B. rossii* and MEL 20342 from "in planitiebus apricis ad fl. Avoca" is here selected as the **lectotype**.

Mueller recognised that *B. rossii* was closely related to *T. sulcata* but distinguished his new species by its smaller stature, branches that lacked pungent tips and calyces which were quasi 4-lobed, the upper lobe being broad and shortly dentate or emarginate apically. Bentham, Fl. Austr. 2:171 (1864), regarded *B. rossii* as a synonym of *T. sulcata* and the two have since been considered conspecific.

#### REPRESENTATIVE SPECIMENS OF TAXON WITH SMALL PODS:

*Western Australia*—Lake Wagin, 1891, *Miss Cronin* (MEL 92113). 19.2 km SW. of Mt. Ragged, 6.xii.1960, *A. S. George 2046* (PERTH). Manmanning Railway Dam Reserve, Avon location 25363, 4.xi.1980, *B. H. Smith* (MEL 580087).

*South Australia*—Alawoona, ii.1913, *J. B. Cleland* (AD 97402057). Eyre Peninsula, Section 21, Hundred of Murlong, 8.xii.1959, *R. L. Specht & C. M. Eardley 2053* (AD 97404431). Northern Yorke Peninsula, ± 5 km S. of Bute, 8.xi.1966, *B. Copley 874* (AD 96708148).

*New South Wales*—Pulletop Nature Reserve, 40 km NW. of Griffith, 30.ix.1969, *J. H. Willis* (MEL 566292). 20 km W. of Balranald, 18.viii.1977, *W. E. Mulham 1222* (NSW 143404). 31 km W. of Euston along Sturt Highway towards Mildura, 18.viii.1979, *M. D. Crisp 5728* (MEL 577902).

*Victoria*—Hattah Lakes National Park, 25.ix.1969, *G. W. Anderson* (MEL 566290). 51.2 km NNW. of Underbool P.O., 28.ix.1972, *A. C. Beauglehole 40494* (MEL 528632). Speed, 27.viii.1979, *M. G. Corrick 6223 & B. A. Fuhrer* (MEL 1515223).

#### REPRESENTATIVE SPECIMENS OF TAXON WITH LARGE PODS:

*Western Australia*—Hines Hill, W. of Merredin, 6.xii.1961, *R. D. Royce 6773* (PERTH). Great Eastern Highway, near old Southern Cross cemetery, 19.ix.1963, *J. H. Willis* (MEL 566295). 11.2 km E. of Winchester, 25.xi.1972, *C. Chapman* (PERTH). Koomburkine, 13.xii.1980, *B. H. Smith* (MEL 580089).

The distinctly flattened stems distinguish *T. sulcata* from both *T. egena* and *T. battii*. The occurrence of the two very closely related leafless taxa with flattened stems that are currently referred to *T. sulcata* is reminiscent of the relationship that exists between *T. egena* and *T. battii*.

#### EXCLUDED SPECIES

*Templetonia regina* J. Drummond, J. Bot. & Kew Gard. Misc. 5: 312 (1853); Ross, Muelleria 4: 389-390 (1981) = **Brachysema aphyllum** Hook., Curtis's Bot. Mag. t. 4481 (1849).

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# THE NOMENCLATURE OF SOME AUSTRALIAN LICHENS DESCRIBED AS LECANORA AND PLACODIUM BY MÜLLER-ARGOVIENSIS

by

R. W. ROGERS\*

## ABSTRACT

J. Müller (Müll.Arg.) described a large number of lichens from Australia. When examining specimens in his herbarium it became apparent that some of the material he described as *Lecanora* and *Placodium* was in need of revision. *Placodium flavostramineum* Müll.Arg. is reduced to synonymy with *Dirinaria applanata* (Fée) Awasthi. *Lecanora connivens* Müll.Arg. and *L. subimmersa* Müll.Arg. (non Vainio) are reduced to synonymy with *L. atra* (Huds.) Ach. while the varieties *L. atra* var. *serialis* Müll.Arg. and *L. atra* var. *virens* Müll.Arg. are considered unworthy of formal taxonomic recognition. The new combinations *Candelariella xanthostigmoides* (Müll.Arg.) R. W. Rogers, *Lecidea glaucoflavens* (Müll.Arg.) R. W. Rogers, *L. hyalinescens* (Müll.Arg.) R. W. Rogers, *Ochrolechia macrosperma* (Müll.Arg.) R. W. Rogers, *Cladonia glaucovirida* (Müll.Arg.) R. W. Rogers, and *Xylographa perminuta* (Müll.Arg.) R. W. Rogers are made. *Lecanora albellaria* Müll.Arg. and *L. glebularis* (Müll.Arg.) Zahlbr. are presented as correct names for two common Australian taxa.

## INTRODUCTION

In March 1978 most of the type specimens of the Australian lichens described by J. Müller (Müller-Argoviensis) were examined in Geneva. When examining the many species of *Lecanora* and *Placodium* that Müller-Argoviensis described it became apparent that some specimens were misplaced in those genera, that others were synonyms of well known lichens, and that others represented common Australian taxa for which no satisfactory name was currently in use. These taxa were typified and relevant details concerning the specimens noted. A copy of the notes is lodged in the National Herbarium of Victoria (MEL).

The specimens discussed in this paper were borrowed from Geneva and examined microscopically. All but one were also examined by thin layer chromatography.

## TAXA REDUCED TO SYNONYMY

***Placodium flavostramineum* Müll.Arg. (1895A:29).**

*Lecanora flavostraminea* (Müll.Arg.) Zahlbr. (1928:621)

TIPIFICATION: *Wilson 331*, on quartz from Victoria (G, holotype). The specimen is a small, closely adnate thallus with marginal lobes.

CHEMISTRY: atranorin and divaricatic acid.

There is no doubt that this is synonymous with *Dirinaria applanata* (Fée) Awasthi, in Awasthi & Agarwal (1970:135).

***Lecanora atra* var. *serialis* Müll.Arg. (1895B:632).**

TIPIFICATION: *Knight 268*, Thursday Island [Queensland] (G, holotype). The specimen is of scattered areoles mostly in the patterns of the rock surface.

CHEMISTRY: atranorin, alectoronic acid,  $\alpha$ -collatolic acid, and phenolics.

Culberson (1969, 1970) and Culberson *et al.* (1977) have documented the chemical variation of *Lecanora atra* (Huds.) Ach. (1810:344) and do not mention the presence of alectoronic acid. Alectoronic acid is similar to  $\alpha$ -collatolic acid, and commonly co-occurs with it in other taxa. Such minor variation in chemistry is insufficient to justify formal taxonomic recognition. In addition, the holotype does

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not differ morphologically from *Lecanora atra* var. *atra*. There is no doubt that *L. atra* var. *serialis* cannot be maintained as a distinct variety, but must be placed in synonymy with *Lecanora atra* var. *atra*.

***Lecanora atra* var. *virens* Müll.Arg. (1882:484)**

TIPIFICATION: *Kirton*, Illawarra, N.S.W. on bark (G, lectotype here chosen. This is the only specimen in Geneva annotated by Müll.Arg.). The grey-green colouration of the thallus is insufficient reason to accord varietal status.

CHEMISTRY: atranorin, allectoronic acid and phenolics.

This taxon cannot be maintained as a distinct variety, for reasons discussed under *L. atra* var. *serialis*. It is synonymous with *Lecanora atra* var. *atra*.

***Lecanora connivens* Müll.Arg. (1891:389)**

TIPIFICATION: *Bailey 435*, corticolous, Queensland (G, holotype).

CHEMISTRY: atranorin, allectoronic acid, and phenolics.

The apothecia are unusually concave in early stages, but later flatten to produce a slightly convex disk and slightly irregular margin, characters insufficient to justify taxonomic recognition. There is no doubt that this taxon is synonymous with *Lecanora atra* var. *atra*.

***Lecanora subimmersa* Müll.Arg. (1893A:124), non *Lecanora subimmersa* Vainio 1890.**

As the name *L. subimmersa* Müll.Arg. is a later homonym and therefore invalid it was replaced by *L. brisbanensis* Zahlbr. (1928:400).

TIPIFICATION: *Bailey 93*, on bark, Brisbane (G, holotype).

CHEMISTRY: atranorin.

The specimen has some of the apothecia partly immersed in the thallus, probably due in part to the highly irregular surface on which the thallus is growing. It does not differ in any significant way from *Lecanora atra*. Both *L. subimmersa* Müll.Arg., *nou. inval.*, and *L. brisbanensis* Zahlbr. must be placed in synonymy under *L. atra* var. *atra*.

## NEW COMBINATIONS

***Candelariella xanthostigmoides* (Müll.Arg.) R. W. Rogers, comb. nov.**

*Lecanora xanthostigmoides* Müll.Arg. (1882:484)

*Candelaria xanthostigmoides* (Müll.Arg.) Müll.Arg. (1893B:33)

TIPIFICATION: *Woolls*, Parramatta N.S.W. (G, lectotype here chosen. This specimen is the more heavily annotated one of the two mentioned by Müll.Arg.); *Sullivan*, Grampians, Victoria (G, syntype).

DESCRIPTION OF LECTOTYPE: *Thallus* a deep yolk-gold crust of scattered granules up to 0.3 mm diameter. *Apothecia* sessile, up to 0.25 mm diameter, with an initially prominent thalline margin which becomes thinner and less prominent, coloured like the thallus; disk more or less plane, deep yolk-gold; asci 8-spored; spores simple, hyaline, 12-15 x 3-4 µm.

***Lecidea glaucoflavens* (Müll.Arg.) R. W. Rogers, comb. nov.**

*Lecanora glaucoflavens* Müll.Arg. (1893B:39)

TIPIFICATION: *Wilson 457*, Warrnambool, Victoria (G, lectotype here chosen. This is the more copious of the two collections mentioned by Müll.Arg.); *Wilson 711*, Warrnambool, Victoria (G, syntype).



DESCRIPTION OF LECTOTYPE: *Thallus* crustose, thin, yellow-green, granular, margin effuse. *Apothecia* sessile, to 1.5 mm diameter, with a distinct pale proper margin when young, less prominent with age; disk flesh-coloured, usually epruinose, plane to slightly convex; paraphyses simple; asci 8-spored; spores simple, hyaline, 18-22 x 9-11  $\mu\text{m}$ .

CHEMISTRY OF LECTOTYPE: isoarthothelin, thyringione.

**Lecidea hyalinescens** (Müll.Arg.) R. W. Rogers, comb. nov.

*Lecanora hyalinescens* Müll.Arg. (1882:484)

TIPIFICATION: *White*, Twofold Bay, on bark [N.S.W.] (G, holotype).

*Thallus* dirty-white to grey, thin, ecorticate. *Apothecia* sessile to somewhat immersed, up to 1 mm diameter; margin white and prominent when young, becoming hyaline and disappearing with age, devoid of algae; disk initially concave, later somewhat convex, pale pinkish-brown to brown; asci 8-spored; spores simple, hyaline, 13-15 x 8-10  $\mu\text{m}$ .

CHEMISTRY: no lichen products were demonstrated by T.L.C.

**Ochrolechia macrosperma** (Müll.Arg.) R. W. Rogers, comb. nov.

*Lecanora macrosperma* Müll.Arg. (1893B:40)

TIPIFICATION: *Wilson 366*, on bark, Lakes Entrance [Victoria] (G, holotype).

*Thallus* crustose, white or grey, thick, densely isidiate. *Apothecia* adnate to immersed, c. 1 mm diameter, thalline margin thick and isidiate; disk deeply sunken within the margin, brown, epruinose; paraphyses reticulately branched; asci 8-spored; spores 38-50 x 18-20  $\mu\text{m}$ , simple, hyaline.

CHEMISTRY: perlatolic acid.

**Cladonia glaucolivida** (Müll.Arg.) R. W. Rogers, comb. nov.

*Placodium glaucolidum* Müll.Arg. (1891:388)

*Lecanora glaucolivida* (Müll.Arg.) Zahlbr. (1928:624)

TIPIFICATION: *Bailey 706*, on soil, Queensland (G, holotype). *Thallus* of squamules up to 1.5 mm across, grey to yellow-grey, usually irregular, sometimes rosette-like, convex or with an ascending tip. *Apothecia* up to 2 mm diameter but usually much smaller, sessile or substipitate, with a well developed margin devoid of algae sometimes disappearing with age; disk brown or pale pinkish-brown, plane becoming somewhat convex, algal layer well developed below the hypothecium; asci 8-spored; spores simple, hyaline, 10-12 x 5-7  $\mu\text{m}$ .

CHEMISTRY: merochlorophaeic acid, 4-0-methylcryptochlorophaeic acid, traces of boninic acid and 2-0-methyl sekikaic acid.

The type specimen is small and poorly developed. However a recent collection (South Nobby, Qld [28°28'S, 153°30'E] on soil on a dry ridge close to the ocean, *Rogers 2394*) shows a fuller development. The short, hollow, corticate podetia could easily be mistaken for a thalloid exciple which would lead to placing the material in the genus *Squamaria* or in *Lecanora*.

**Xylographa perminuta** (Müll.Arg.) R. W. Rogers, comb. nov.

*Lecanora perminuta* Müll.Arg. (1893B:39)

TIPIFICATION: *Wilson 1694*, dead wood, Mt. Macedon [Victoria] (G, holotype).

*Thallus* not detectable. *Apothecia* black or very dark brown, minute (0.1-0.2 mm diameter), irregular, with a poorly developed thalline exciple, more or less adnate to the substrate; paraphyses simple; asci 8-spored; spores simple, hyaline, 6-12 x 4-5  $\mu\text{m}$ .

CHEMISTRY: no lichen products were demonstrated by T.L.C.

## SPECIES OF SPECIAL INTEREST

**Lecanora albellaria** Müll.Arg. (1895B:632)

TIPIFICATION: *Knight 423*, on bark, Qucensland (G, holotype). *Thallus* white, thin, chinky to granular. *Apothecia* sessile; thalline margin well developed, thick, prominent, entire or slightly irregular; disk sunken, flat to concave, pale pinkish-brown, sometimes becoming hyaline; asci 8-spored; spores 5-7 x 10-13  $\mu\text{m}$ , simple, hyaline.

CHEMISTRY: atranorin, 2-0-methylperlatolic acid.

Similar material is very common on mangroves on the eastern coast of Australia, from Cairns to Sydney.

**Lecanora glebularis** (Müll.Arg.) Zahlbr. (1928:624).

*Placodium glebulare* Müll.Arg. (1888:204)

TIPIFICATION: *C. French*, Lake Albacutya, Victoria, on soil (G, holotype). *Thallus* white, areolate, the areolae strongly convex. *Apothecia* 0.5-1.0 mm diameter, solitary and sessile on the areoles; margin prominent, permanent, coloured like the thallus; disk plane or somewhat convex, black, epruinose; asci 8-spored; spores 6-8 x 7-10  $\mu\text{m}$ , simple, hyaline.

CHEMISTRY: atranorin, 2-0-methylperlatolic acid.

Similar material is widespread on soils in semi-arid Victoria, New South Wales and South Australia. All material treated as *Lecanora atra* by Rogers and Lange (1972) is *L. glebularis*. *L. atra* differs chemically (atranorin, aleatoronic acid,  $\alpha$ -collatolic acid) and also has much larger apothecia which are not born at the apex of almost globular arcoles.

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# NEW AUSTRALIAN SPECIES OF NYMPHOIDES SÉGUIER (MENYANTHACEAE)

by

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## ABSTRACT

*Nymphoides montana*, *N. planosperma*, *N. quadriloba*, *N. spongiosa* and *N. subacuta* are described as new species from Australia. Full descriptions and illustrations, together with notes on distribution, habitat and diagnostic features are provided.

## TAXONOMY

This paper is a precursor to a revision of *Nymphoides* Séguier in Australia.

All five species described have the following characteristics in common:

Attached, emergent, glabrous, aquatic herbs. *Leaf blades* floating. *Pedicels* erect to semi-erect and emergent when in flower, recurved and submerged when in fruit. *Flowers* regular, bisexual, heterostylous, either long- or short-styled. *Calyx* divided almost to the base. *Corolla* sympetalous, c. 2-2.5 times as long as the calyx (3 times as long in *N. montana* and *N. subacuta*). *Corolla lobes* alternate to the calyx lobes, induplicate-valvate in bud, spreading at maturity,  $\pm$  emarginate, each lobe consisting of a lanceolate mid-section with a transverse fringe of long fine papillae just above its base and with two broad side-wings. *Corolla tube*  $<$  calyx, with a cluster of short papillae on the midline between the filament bases. *Stamens* as many as the corolla lobes, inserted on the corolla tube at the junction of the lobes; filaments short; anthers bilocular, dorsifixed, dehiscent introrsely by longitudinal slits, the locules of each anther united by a  $\pm$  fleshy dorsal connective along their distal half to four-fifths, free but  $\pm$  appressed basally. *Ovary* superior (almost so in *N. montana* and *N. subacuta*), unilocular with parietal placentation, with small, obtuse, hair-tipped nectaries projecting from the base of the ovary wall opposite the midlines of the corolla lobes. *Style* simple, apical. *Stigmas* as many as the placentas. *Fruit* a capsule surrounded by the persistent calyx, usually indehiscent and ripening underwater.

Each species is placed in either a "geminata group" or an "indica group" of species. These two groups are readily distinguished by both corolla colour and inflorescence although the distinction based on corolla colour is not infallible outside Australia (Ornduff, 1969; Ornduff and Mosquin, 1970).

*Corolla* yellow to orange; *inflorescence* indeterminate, lateral or terminal, typically lax and floating with a pair of pedicellate flowers and two semi-amplexicaule bracts at each node, the bracts of each pair  $\pm$  opposite, with one subtending the two pedicels and the other clasping the stem .....  
..... "geminata group" (*N. montana*; *N. subacuta*)

*Corolla* white pinkish or mauve, yellow only in the throat; *inflorescence* a dense cluster of pedicels arising unilaterally at the junction of a long petiole-like stem and a true petiole, the true petiole either resembling a short continuation of the stem or else minute and apparently absent, the floating leaf blade then sessile at the inflorescence .....  
..... "indica group" (*N. planosperma*; *N. quadriloba*; *N. spongiosa*)

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**Nymphoides montana** H. I. Aston, sp. nov.*Nymphoides geminata* sens. Aston (1973:111), non (R.Br.) Kuntze.*Nymphoides* sp. nov. "G", Aston in litt.

Plantae perennes. Stolones fluitantes ad 2 m longi. Laminae foliorum  $\pm$  circulares, integrae, profunde cordatae, latissime obtusae, (2.5-)4-11 x (2.5-)4-10.5 cm. Inflorescentia laxa, binis floribus pedicellatis binisque bracteis ad nodos; internodis ad 5(-10) cm longis. Flores heterostyli, 5(6)-partiti. Corolla 23-38 mm diametro, flava; lobae alis lateralibus latis perlaciniatis, fimbriaque transversa prope lobae basin papillarum tenuium liberarum formata, praeditae. Capsula ellipsoidea, (5.5-)6-9 x (3-)4-5 mm. Semina 42-90 per capsulam, ellipsoidea valde autem compressa, 1.1-1.55 x 0.8-1.15 x 0.5-0.7 mm (longitudo latitudine sesquialongior, crassitie duplo longior), nigrescentia ad nigra maturitate, nitentia, laevia; caruncula basalis circularis, pallida, tenuis, inconspicua.

Stoloniferous perennial. *Stolons* long and floating with roots suspended from the nodes on plants in water, becoming rooted to the substrate when waters evaporate; stolons in deeper waters to 2 metres long x 1.5-4 mm diam. with internodes c. 10-60 cm long, mostly few-noded and forked once to thrice; stolons on stranded plants often reduced to a single node 1-2 cm long. *Basal leaves* several; petioles slender, cylindrical, to 70 cm long; blades  $\pm$  circular in outline, usually a little longer than broad, occasionally a little broader than long, rarely very broad-ovate, deeply cordate (the lobes mostly 30-45% of the total blade length and separated by a sinus of 0°-40° (-70°) or rarely slightly overlapping), very broad-obtuse, often somewhat emarginate, entire or rarely slightly crenate, (2.5-)4-11 x (2.5-)4-10.5 cm. *Cauline leaves* from the stolon nodes similar, becoming progressively smaller and shorter-petioled toward the stolon extremities, those on stranded plants reduced in size (sometimes < 1 cm) and varying from reniform to elliptic and from cordate to truncate to tapered at the base. *Inflorescence* as for the "geminata group", the internodes few-11 in number, each 2-50(-100) mm long; bracts lanceolate-ovate, 4-7(-10) mm long; pedicels 20-80(-125) mm long. *Flowers* 5(6)-partite. *Calyx lobes* lanceolate to narrow-ovate, thick-textured with narrow translucent margins, (5-)6-8(-10) mm long. *Corolla* 23-38 mm span, "bright lemon yellow" to "bright yellow". *Corolla lobes* broad-elliptic; mid-section glabrous except for the conspicuous transverse fringe of fine papillae near its base and sometimes a few similar papillae along its midline above the fringe; side-wings broad, undulate, strongly lacinate, extending from the apex of the lobe almost to the base. *Corolla tube* papillae free within the cluster, sessile. *Stamens* with filaments c. 0.6 and 1.7 mm long in long-styled and short-styled flowers respectively; anthers  $\pm$  linear-ovate, c. 2.5-3.5 times as long as broad, 2.4-3.5 mm long. *Gynoeceium (long-styled flower)* c. 10.5 mm long; ovary free except at the base,  $\pm$  linear-conical, gradually tapered into the style; placentas 2, long, extending down at least the central half of the ovary wall; ovules c. 90-170; style c. 2.5-3.5 mm long; stigmas 2, each a broad-rhomboid, shortly-papillate, lacinate, erect wing c. 3.5 x 2.75 mm. *Gynoeceium (short-styled flower)* c. 6 mm long; style c. 1.5 mm long; stigmas c. 2 x 2.5 mm, condensed, deeply-lobed and undulate thus obscuring the basic wings. *Capsule* ellipsoid, equal to or a little longer than the calyx, (5.5-)6-9 x (3-)4-5 mm, often breaking free in the water by decay of the pedicel before the seeds are released. *Seeds* (23-)42-90 per capsule; body of seed ellipsoid but strongly laterally compressed, 1.1-1.55 mm long x 0.8-1.15 mm wide x 0.5-0.7 mm thick, dark grey-black to black when mature, shining, smooth; basal caruncle present, circular, pale, thin and generally inconspicuous.

## TYPE COLLECTION:

Lake Hill, south-west of Nunniong Plains, East Gippsland, Victoria, grid W6(-3), 20.i.1971, *Beaughtehole & Finck ACB36345* (Holotype: MEL 1504963. Isotypes: BRI, CANB, MEL 1504964-965, NSW).

## PARATYPE:

Morass Creek, about 9 km north of Benambra, at crossing of the Omeo to



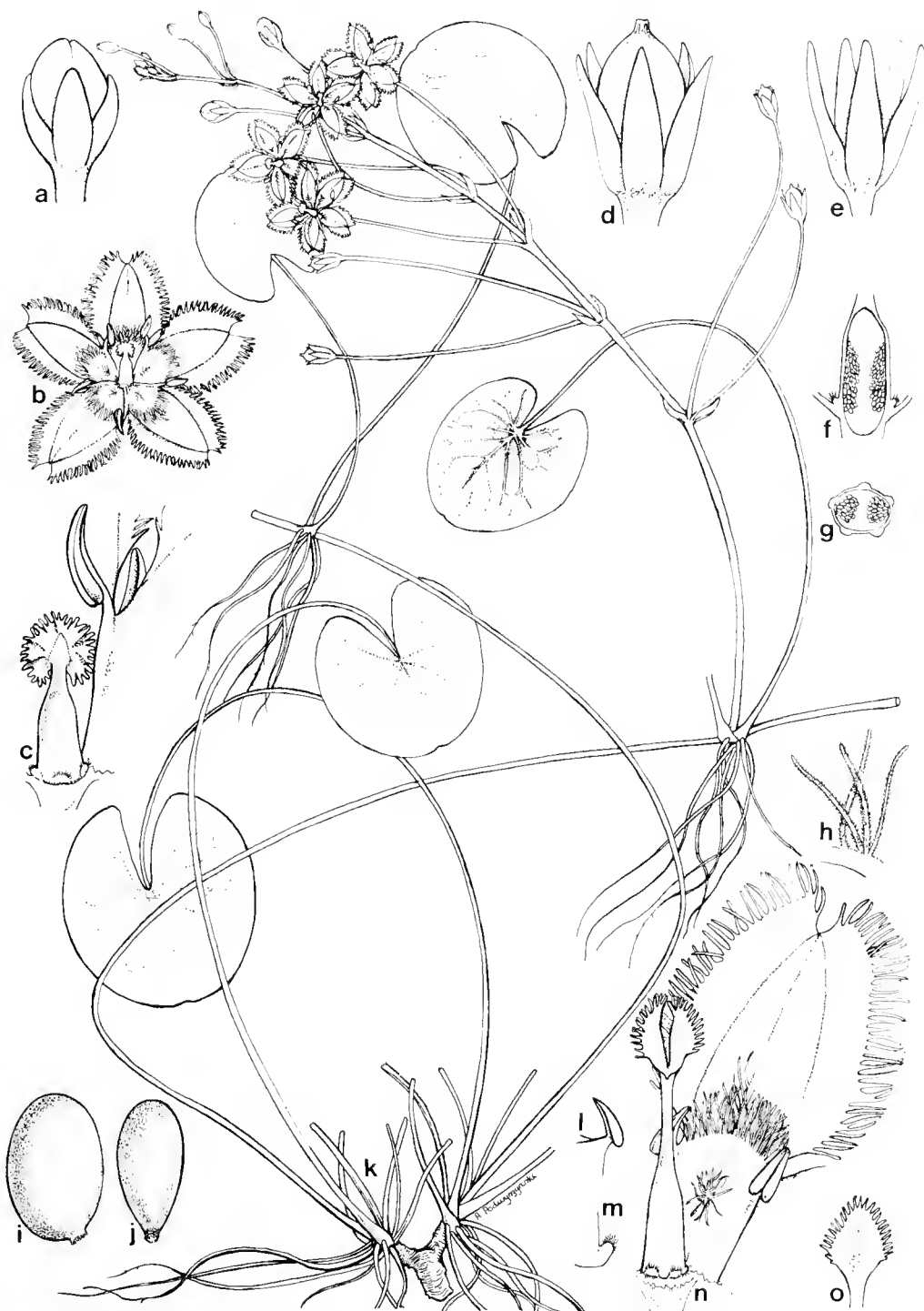


Fig. 1. *Nymphoides montana*. a—bud, x 3; b—flower, x 1.5; c—portion of short-styled flower showing relative proportions of stamen and gynoecium, x 4; d—capsule and persistent calyx, x 3; e—calyx, x 3; f—L.S. of ovary showing its partially-inferior structure and long parietal placentas, x 5; g—T.S. of ovary, x 5; h—papillae from the transverse fringe on the corolla lobe, x 12; i—seed, face view, x 15; j—seed, edge view, x 15; k—habit, x 0.4; l—stamen from long-styled flower, edge view, showing the dorsal connective, x 4; m—nectary, lateral view, x 8; n—portion of long-styled flower, x 4; o—stigma from long styled flower, face view, x 4. All from Aston 1852 (MEL).



Corryong road, 36°52'S, 147°42'E, Victoria, 12.iii.1975, *Aston 1852* (MEL 1504989-999, NSW).

#### SELECTED SPECIMENS EXAMINED (total 37):

*New South Wales*—Delegate River, c. 0.7 km west of Delegate, 37°31'S, 148°55'E, 19.ii.1975, *Aston 1819* (CANB, MEL 1504984-88, NSW), Umaralla River, c. 1 km upstream from Newmeralla, 36°11'S, 149°21'E, 20.ii.1975, *Aston 1821* (MEL 1504947-51, NSW). Black Bobs Creek, c. 13 km direct line SSW. of Nerriga, 35°13'S, 150°01'E, 24.ii.1975, *Aston 1823* (BRI, CANB, MEL 1504938-42, NSW). Ner-runga Creek, c. 40 km SSE. of Goulburn, 35°05'S, 149°53'E, 24.ii.1975, *Aston 1824* (MEL 1504975-77, NSW). Wingecarribee River, between Bowral and Moss Vale, 34°32'S, 150°23'E, 25.ii.1975, *Aston 1827* (MEL 1504971-74). Dumaresq Dam, 30°25'S, 151°36'E, 1.iii.1975, *Aston 1836* (MEL 1504978-83, NSW). Walcha district, xii.1898, *Betche s.n.* (NSW 136699). Upper Shoalhaven River near Kain, 27.xii.1965, *Briggs s.n.* (NSW 91535). Wingecarribee swamp, c. 10.4 km ENE. of Moss Vale, 26.ii.1969, *Coveny 898* (MEL 1504953-54, NSW).

*Australian Capital Territory*—Smokers Gap, Tidbinbilla Range, 19.ii.1967, *Adams 1678* (CANB 166808-09). Paddys River on Tidbinbilla road, 6.iv.1955, *Burbidge 3965* (CANB 251843). "Booroomba", 9.iii.1954, *Moore 2889* (NSW).

*Victoria*—Little River, on Rockbank Station, c. 6 miles north of Wulgulmerang P.O., 27.i.1965, *Aston 1335* (MEL 1504927-30). About 1 mile west of Wulgulmerang-Suggan Buggan road, on K. C. Roger's property [Rockbank Station], 7.i.1970, *Beaglehole, Rogers & Finck ACB 33364* (MEL 1504961). Sailors Lake, c. 2 miles SW. of Wulgulmerang P.O., 12.i.1971, *Beaglehole & Rogers ACB 36047* (ACB, MEL 1504955-57). Bentleys Plain, 23.ii.1971, *Beaglehole ACB 36998* (MEL 1504966-67, NSW). Bentleys Flat, below Mt. Nugong, c. 12 miles NNE. of Ensay, 26.i.1953, *Melville 3124 & Wakefield* (MEL 1504924, NSW). Morass Creek, near The Brothers, Benambra, 31.i.1946, *Willis s.n.* (MEL 1504937).

#### DISTRIBUTION:

Mid-altitude plains and Tableland regions of eastern Victoria and eastern New South Wales, including the Australian Capital Territory, from about Omeo (Vic.) to Armidale (N.S.W.). Most frequent through the Benambra—Ensay—Wulgulmerang—Bonang area of Victoria and the Southern Tablelands of New South Wales, continuing north to about Bowral—Moss Vale and Yerranderie, then re-appearing in the Northern Tablelands around Armidale—Walcha. Altitudinal range c. 600-1300 (-1400) metres.

#### HABITAT:

Typically edging creeks and rivers in slow-flowing, fresh, clear water to one metre deep or in still backwaters or river pools; occasionally in still clear swamps or briefly surviving on saturated soil following a fall in water level. Persistent in creeks flowing through long-established grazing lands. Mostly in sand or light gravel, occasionally soft mud. Fl. and Fr. recorded December—6 April.

#### NOTES:

Readily recognised as a member of the "geminata group" by the yellow flowers and open inflorescence with twinned pedicels. Its smooth, ellipsoid but strongly compressed seeds (length equals about one and a half times the width and twice the thickness) are quite different to the highly-sculptured,  $\pm$  globular and only slightly compressed seeds of all other species of that group except *N. crenata* (F. Muell.) Kuntze. The latter species has compressed-ellipsoid seeds which are only slightly smaller than those of *N. montana* and which, in some populations, are smooth, but they lack a caruncle. In other characters *N. crenata* is quite distinct.

The epithet *montana* is selected because of the typically montane distribution. Of two collections which purport to have originated from lowland regions of Victoria near Orbost, one (MEL 1504908), although with seed which confirms its identity as *N. montana*, is of doubtful locality and the other (MEL 1504917-919) lacks seed and is of both doubtful identity and doubtful locality.

Fully-formed seeds are at first cream- to straw-coloured then darken through grey-browns to black. Because older capsules frequently become detached through pedicel decay mature black seeds are often missing from collections. As seeds provide the chief diagnostic distinctions of *N. montana* I have chosen as type collection the only one available which has enough mature seeds to provide isotypes for

distribution and to withstand the ravages of time. However, this collection (ACB 36345) is deficient in other respects, particularly in having only small, thin-textured leaves, some of which (including two on the holotype) are atypically deeply emarginate. I have cited, therefore, a paratype (Aston 1852) which complements the type collection by illustrating the typical large thick-textured leaves, the stoloniferous habit and elongated inflorescences of deepwater plants and also the reduced state of plants on mud.

Collections from the Bentley Plains, Victoria (ACB 36998; Melville 3124) show a slight tendency towards a tuberculate seed. This is more pronounced in the latter collection where the external surfaces of some of the seed cells form semi-circular domes and a very few form small tubercles about once to twice as long as broad. These extrusions are confined to the seed edges and only noticeable under magnification.

At some localities both long- and short-styled flowers are found on intermingled stolons but at others only one style type is present over an extensive area or throughout the population. The latter situation is possibly due to the stoloniferous nature of the species and the consequent vegetative spread and formation of large clones.

***Nymphoides planosperma* H. I. Aston, sp. nov.**

*Nymphoides* sp. nov. "R", Aston in litt.

Plantae annuae. Laminae foliorum sagittata,  $\pm$  ovate-triangularis, 8-17 x 9-16 mm, sino profundo acutoque (ad 60(-70%) totae folii longitudinis), lobae basales elongatae, angustae, 2-6 mm latae; laminae infra spongiosae rugosaeque, stellatis trichomis furcatis in cavernulis aëriis. Inflorescentia fasciculus pedicellarum densus, ad basin sinu folii ortus. Flores heterostyli, 5-partiti. Corolla 6-10 mm diametro, alba, fauce flavo; lobae cum alis latis lateralibus in distali  $\frac{1}{2}$ - $\frac{3}{4}$ , atque fimbria sparsa transversa papillarum tenuium prope lobae basin; alae laterales undulatae ad apicem laciniatae alibi integrae. Capsula ellipsoidea ad late ovoidea, ad  $1\frac{1}{2}$  longior quam calyx, 1.5-2.5 x 1.5-2 mm; placentae duae, subapicales, minutae. Semina 1-4 per capsulam, anguste-ellipsoidea sed valde compressa, (1-) 1.42-2.25 x (0.5-) 0.8-1.05 x (0.35-) 0.45-0.6 mm (longitudo latitudine diplo longior, crassitie 3-4 plo longior) nigra maturitate, typice cum superficiebus  $\pm$  laevibus, cumque margine incrassata, obtusituberculata, rotundata; caruncula crassa, semicircularis, conspicua, in margine seminis circa  $\frac{1}{3}$  longitudinis ab apice.

Annual. *Petiole-like stems* few to many, arising from the plant base, flexuose, threadlike, 7-34 cm long x < 0.5 mm diam., with scattered, flat, often dark callosities; true petiole minute or absent. *Leaf blades*  $\pm$  ovate-triangular in outline with slightly convex, straight, or slightly concave edges and a usually deep and acute basal sinus; sinus (30-)50-60(-70)% of total blade length, of 50°-100° (-125°) angle, the basal lobes  $\pm$  elongated and narrow, 2-6 mm wide; blades 8-17 mm x 9-16 mm, widest across the basal lobes close to their extremities, spongy and rugose beneath with deep air cavities and with  $\pm$  stellate/forked clear-translucent trichomes projecting into the cavities from the inside of the upper leaf surface. *Inflorescence* as for the "indica group"; true petiole apparently absent; pedicels subtended by broad-obovate to  $\pm$  rounded, white-translucent, membranous bracts to 2 mm long. *Pedicels* 5-12, emerging erect through the sinus when in flower, very slender, 5-18 x c. 0.2 mm, with scattered flat callosities. *Flowers* 5-partite. *Calyx lobes* linear-lanceolate to narrow elliptic-lanceolate, slightly mucronate, membranous, 1-nerved, remaining closely appressed to the capsule, with 1-several flat, often dark, callosities particularly along the nerve, 1-1.5(-1.9) mm long. *Corolla* 6-10 mm span, 3-5 mm long, white with a yellow throat. *Corolla lobes* distally broad-elliptic, basally linear; mid-section glabrous except for a sparse transverse fringe of fine papillae near its base; side-wings broad, undulate, laciniate at the apex but otherwise entire, extending from the apex down the distal half to two-thirds of the lobe. *Corolla tube* papillae clustered at the apex of a pronounced common stalk. *Stamens* with filaments c. 0.3-0.5 and 1.2 mm long in long-styled and short-styled flowers respectively; anthers versatile,  $\pm$  broad-oblong, only slightly longer than broad, c. 0.45-0.5 mm long. *Gynoecium (long-styled flower)* c. 2.5-3 mm long; ovary globular-obovoid, contracted  $\pm$  abruptly into the style; placentas 2, minute,

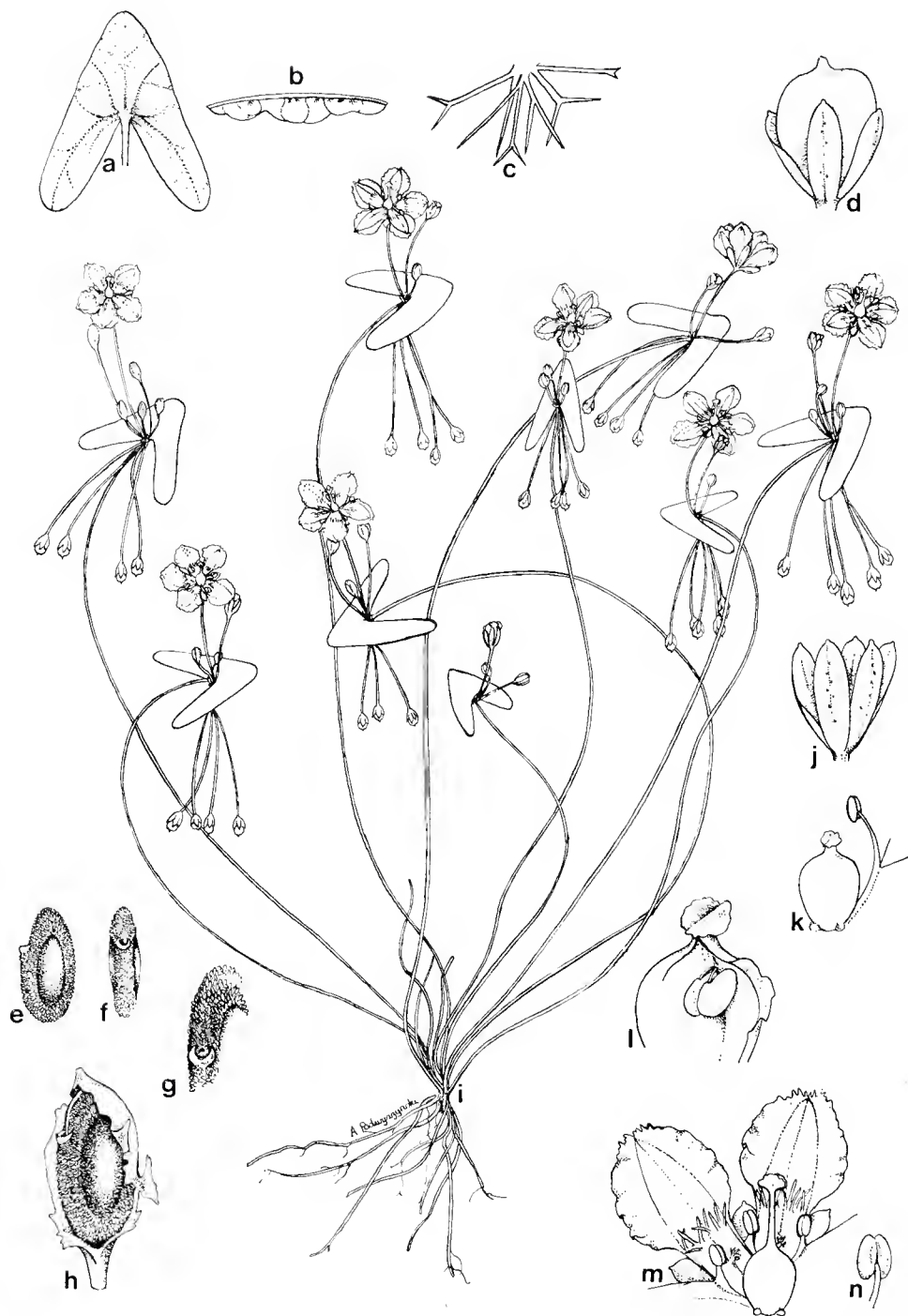


Fig. 2. *Nymphoides planosperma*. a—leaf, showing spongy rugose undersurface, x 2; b—leaf, T.S. showing air cavities and trichomes, x 3; c—trichome from leaf cavity, x 200; d—capsule and persistent calyx, x 9; e—seed, face view, x 8; f—seed, edge view, x 8; g—seed, caruncular area, x 16; h—seed in situ in torn capsule, showing funicle extending from the near-apical placenta to the lateral caruncle, x 12; i—habit, x 1; j—calyx, x 10; k—portion of short-styled flower showing relative positions of stamen and gynoecium, x 8; l—ovary, opened distal portion showing one of the near-apical placentas with its two ovules, x 14; m—portion of long-styled flower, x 8; n—anther, dorsal view, showing connective and versatile attachment, x 16. All from Craven 6607 (MEL).

parietal but near-apical; ovules 2-4, i.e. 1-2 per placenta; style c. 1-1.5 mm long; stigmas 2, each a broad, papillate, irregularly-shaped, somewhat laciniate wing c. 0.4-0.5 mm long. *Gynoecium* (short-styled flower) c. 1.4-1.5 mm long; style c. 0.2 mm long; stigmas c. 0.2-0.3 mm long, condensed. *Capsule* ellipsoid to broad-obovoid, distorted when the ovules of one placenta fail to develop, from a little longer than to one and a half times as long as the calyx, 1.5-2.5 x 1.5-2 mm. *Seeds* 1-4 per capsule; body of seed narrow-ellipsoid, strongly laterally compressed, (1-)1.42-2.25 mm long x (0.5-)0.8-1.05 mm wide x (0.35-)0.45-0.6 mm thick, black when mature, typically with  $\pm$  smooth and slightly convex faces and a thickened, tuberculate,  $\pm$  round-edged perimeter, the perimeter projecting laterally to almost the same plane as the centre-face and thereby giving an impression of flatness to the seed; tubercles short and blunt; caruncle pale, thick, semicircular, positioned on the seed edge about one-third of the seed length from the apex; seed about as long as the capsule, attached by a short straight funicle; typical edges not always developed and seeds then smooth and wholly biconvex.

#### TYPE COLLECTION:

Northern Territory, Kakadu National Park, c. 22 km north-east of Jabiru, 12°31'S, 132°58.5'E, 30.iii.1981, *Craven 6607* (Holotype: MEL 1520239. Isotypes: MEL 1520238, also (not seen) at CANB and to be distributed).

#### SPECIMENS EXAMINED:

*Northern Territory*—Kakadu National Park (stage 2 of park not gazetted at time of collecting), c. 15 km NNE. of Jabiru, 12°31.5'S, 132°55'E, 22.iii.1980, *Craven 6544* (CANB (not seen); MEL 1520373). Jabiluka Outlier, "Cannon Rock" Creek, pool number 1, 30.iii.1980, *Sanderson 9635* (Univ. New South Wales). Ibidem, pool number 2, 30.iii.1980, *Sanderson & Waterhouse 9634* (Univ. New South Wales). Just north of "Cannon Rock", Jabiluka Outlier, 23.iii.1980, *Sanderson & Waterhouse 9574* (Univ. New South Wales).

#### DISTRIBUTION:

*Northern Territory*—Known only from an area of about 6-10 kilometres width just north and north-north-east of Jabiru and west of the East Alligator River. Possibly widespread but uncollected over the escarpments of Arnhem Land.

#### HABITAT:

Temporary seasonal freshwaters of shallow rockpools on the exposed plateaus of rocky sandstone escarpments. In water to 25 cm deep.

#### NOTES:

Readily recognised as a member of the "indica group" by the white flowers (yellow only in the throat) and the clustered inflorescence arising from the apparent petiole against the leaf blade. It differs from all other species of that group in its distinctive seed characters (elongated and  $\pm$  flattened; length approximately twice the width and 3 to 4 times the thickness; caruncle lateral instead of basal) and in the placentas being near-apical and minute rather than centrally-positioned and  $\pm$  elongated down the length of the ovary wall. The spongy and rugose (not smooth) leaf undersurface is distinct from that of all species except *N. minima* (F. Muell.) Kuntze. However, the leaf of *N. minima* is  $\pm$  ovate, cordate, and broad-obtuse whereas that of *N. planosperma* is more arrow-shaped with a deeper basal sinus, longer narrow spreading basal lobes, and narrow-obtuse apex. Some of the more concave-sided leaves of *N. planosperma* are similar in shape to those of *N. furculifolia* Specht. The very few ovules and seeds of *N. planosperma* and the  $\pm$  stellate/forked hairs within the leaf cavities should also be noted.

The epithet *planosperma* is chosen because of the comparative flatness of the typical seeds in relation to those of other Australian species. The impression of flatness is greatest when the thick rounded edges are developed to the maximum extent (type collection) and it is quite absent where the seed edges fail to develop (*Sanderson & Waterhouse 9634*).



Although I have only dissected long-styled and short-styled flowers N. T. Sanderson and J. T. Waterhouse report (pers. comm.) three style types from field observations—long, medium and short. Medium-styled plants only were found in one pool and both long- and short-styled plants were found together in another. The medium-styled plants produced 3 or 4 of the smallest known seeds per capsule whereas the long- plus short-styled population produced 1 or 2 larger seeds per capsule. Observed populations are insufficient to determine if this distinction is constant.

***Nymphoides quadriloba* H. I. Aston, sp. nov.**

*Nymphoides* sp. nov. "P", Aston in litt.

Plantae annuae vel ?perennes. Laminae saepe foliorum hippocrepiformes vel late sagittiformes (1-)3-9.5(-11) x (0.8-)2-8 cm, late ellipticae ad  $\pm$  rotundae vel late deltoideae sed cum sino basali plerumque lato convexoque; lobae basales obtusae, marginibus interioribus vulgo concavis. Inflorescentia fasciculus pedicellorum densus, ad basin sinus folii ortus. Flores heterostyli, 4(5)-partiti. Corolla (6-)11-17(-19) mm diametro, vel alba vel pallide erubescens vel pallide malvinus-erubescens, fauce flavo; lobae cum duabus alis latis lateralibus profunde laciniatis, ab apice paene usque ad basin, atque cum carina verticali lata laciniata, longitudinali in superficie interiore; carina plerumque ab apice ad  $\frac{1}{3}$ - $\frac{2}{3}$  lobae longitudinem, nonnumquam valde deminuta; loba et cum fimbria conspicua proxime super basin papillarum tenuium. Capsula ellipsoidea ad late-ellipsoidea, 2.5-5 x 1.7-3 mm. Semina (5-)10-44(-61) per capsulam, paene globosa sed compressa (typice superficibus laevibus convexis cum protuberatione centrali, marginibus dense tuberculis brevibus obtusis velatis; tubercula nonnumquam desunt, nonnumquam autem et in superficibus lateralibus et in marginibus tubercula adsunt), 0.67-1.02 x 0.6-0.95 x 0.35-0.57 mm (longitudo latitudinem  $\pm$  aequans, crassitie duplolongior), straminea ad atrofusca vel nigra maturitate; caruncula basalis, circularis, plerumque tenuis inconspicuaeque.

Annual, perhaps perennial where water persists. *Petiole-like stems* few to many, arising from the plant base, slender, flexuose, 7 cm (plants on mud) to 85 cm (plants in water) long x 1 mm or less diam.; true petiole c. 1-3 mm long. *Leaf blades* very variable, typically horseshoe- or broad arrow-shaped, obtuse to rounded, entire-margined, broad-elliptic to  $\pm$  broad-deltoid in outline but with a shallow to deep, often broad, generally convex basal sinus (sinus mostly (25-)40-60% of the total blade length and of (30°-) 55°-100°(-130°) angle); basal lobes obtuse, their inner margins generally concave, their outer margins a continuation of the convex curve of the whole leaf edge; leaves (1-)3-9.5(-11) cm long x (0.8-)2-8 cm wide, (length =, >, or < width) green and shining above, not spongy. *Juvenile leaves* sometimes present on mature plants, submerged, near-sessile at the plant base, very thin-textured, deltoid to rhomboid. *Inflorescence* as for the "indica group". *Pedicels* (8-)14-25(-35), emerging erect through the sinus when in flower, very slender, 17-52 x <0.5(-1) mm. *Flowers* 4(5)-partite. *Calyx lobes* lanceolate to narrow-ovate, acute, thin-textured, greenish or purplish with translucent margins, outcurved at the apex in fruit, 2.5-4.5 mm long. *Corolla* (6-)11-17(-19) mm span, white or very pale pink or pale mauve-pink except for a yellow throat; colours also grading (see notes below). *Corolla lobes* broad-elliptic, emarginate; mid-section with a broad, lacinate, vertical keel on its upper surface and with a conspicuous transverse fringe of fine papillae just above its base; keel extending longitudinally down the distal one- to two-thirds of the lobe length and continuing proximally as a line of individual fine papillae, but sometimes (even on the same flower) reduced to a very small keel on the distal or near-central portion of the lobe; side-wings broad, undulate, deeply-lacinate, extending from the apex almost to the lobe base. *Corolla tube* papillae short,  $\pm$  thick and blunt, free and sessile or arising from the apex of a short thick common stalk. *Stamens* with filaments c. 0.5-0.75 and 1.2-1.3 mm long in long-styled and short-styled flowers respectively; anthers  $\pm$  broad-linear to elliptic, c. 1.5 times as long as broad, 0.7-1.3 mm long. *Gynoecium (long-styled flower)* c. 3-4.5 mm long; ovary ellipsoid to broad-ellipsoid, contracted into the style but not abruptly so; placentas 2, about one-quarter to one-third of the capsule length, positioned centrally down the ovary wall; ovules c. (16-)23-50(-62); style c. 1.5-1.8 mm long; stigmas 2, each a broad, papillate, irregularly-shaped and moderately lacinate wing c. 1 mm long. *Gynoecium (short-styled flower)* c. 2-3 mm long; style c. 0.3-0.6



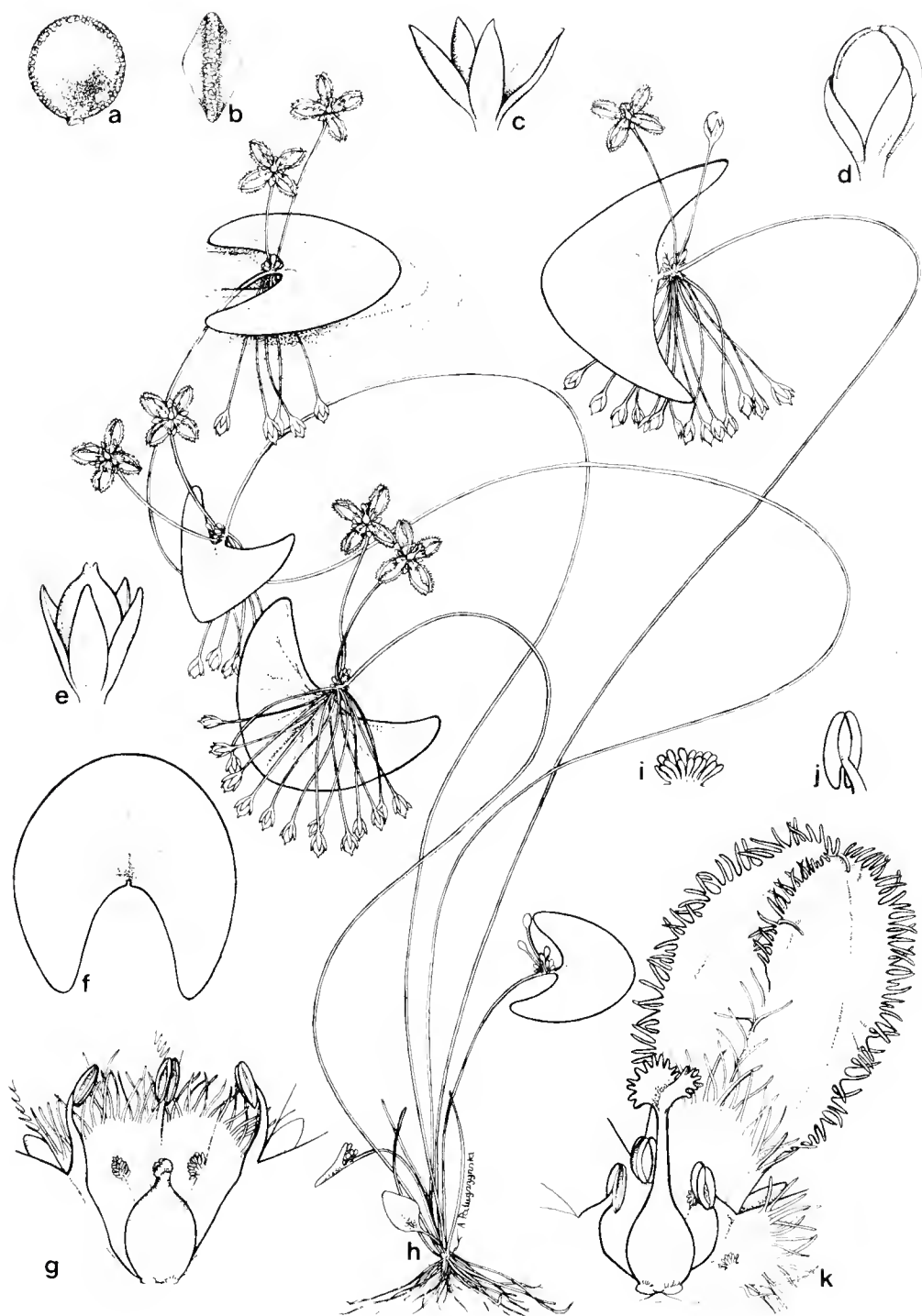


Fig. 3. *Nymphoides quadriloba*. a—seed, face view, x 22; b—seed, edge view, x 22; c—calyx, x 4; d—bud, x 4; e—capsule and persistent calyx, x 4; f—leaf, horseshoe-shaped, x 0.7; g—portion of short-styled flower showing relative positions of stamens and gynoceium, x 11; h—habit, plant with  $\pm$  arrow-shaped leaves, x 0.7; i—cluster of papillae from corolla tube, x 25; j—anther, dorsal view showing connective, x 16; k—portion of long-styled flower, x 11. f from Aston 1944 (MEL); remainder from Aston 1898 (MEL).

mm long; stigmas 0.2-0.65 mm long, condensed, rather lobed and undulate. *Capsule* ellipsoid to broad-ellipsoid, from a little < to a third as much again as the calyx, 2.5-5 x 1.7-3 mm. *Seeds* (5-)10-44(-61) per capsule, shaped as described below, 0.67-1.02 mm long x 0.6-0.95 mm wide x 0.35-0.57 mm thick, cream-straw to brown-black or black when mature, with a circular basal caruncle. *Seed from typical populations* near-globose but moderately laterally-compressed with the faces smooth and convex and with a pronounced central bulge, the edges densely covered with short obtuse tubercles which are directed diametrically outwards and together give a  $\pm$  square-cut appearance to the edge; may be modified by absence of the tubercles to give a fully-smooth seed or by greater spread of the tubercles so that they cover the side-faces (rarely also the centre-faces) as well as the edges; caruncle  $\pm$  thin and inconspicuous. *Seeds from Carpentaria populations* (see distribution and notes) have faces uniformly biconvex instead of centrally-bulged; tubercles mostly moderately to densely placed over the whole surface but variously reduced in extent, sometimes almost absent thus giving smooth seeds; caruncle usually thick and conspicuous.

#### TYPE COLLECTION:

About 3 miles NNE. of Katherine, Northern Territory, 10.iv.1967, *Adams 1747* (Holotype: CANB 172340. Isotypes: CANB 172339, K, NSW, NT 39334, also (not seen) at A, E, L, US). The locality on the K and NT sheets, and probably also on the unseen isotypes, is given as about 2 miles north of Katherine, but this has been corrected on the CANB sheets to that cited above. The location is on the property of L. J. Phillips (Adams, pers. comm.).

#### PARATYPE:

Property of L. J. Phillips, about 5-8 km NNE. of Katherine, c. 14°25'S, 132°18'E, Northern Territory, 7.v.1976, *Aston 1898* (BRI, CANB, MEL 1505244-45, PERTH).

#### SELECTED SPECIMENS EXAMINED (total 27):

*Western Australia*—Lake Gilbert, North Beverley Springs Homestead, West Kimberley, 16°35'S, 125°29'E, 1.ix.1974, *Kenneally 2193* (PERTH).

*Northern Territory*—Arnhem Highway, 10 km ESE. of its junction with the Stuart Highway, 12°36'S, 131°11'E, 18.v.1976, *Aston 1940* (MEL 1505242-43, NT). Survey Creek, 10.iii.1970, *Byrnes 1818* (DNA 2767, NT 24449). 2.5 miles SW. of Fountain Head, 17.iii.1961, *Chippendale 7697* (MEL 1505250, NT 7697). 12°36'S, 133°15'E, 19.ii.1973, *Craven 2286* (CANB 240521-22, MEL 537848). Lagoon west of Round Billabong, Kapalga study area, 12°27'S, 131°19'E, 1.vii.1977, *Craven 4511* (CANB 271651). Cox River Station, lagoon near Arnold River, 15°49'S, 134°36'E, 30.vi.1977, *Henshall 1567* (MEL 521380, NSW, NT 52204). Arnhem Highway, 2 km east of Mary River, 12°39'S, 131°50' [240'] E, 5.iii.1978, *Henshall 1938* (NT 54816). 4 km west of Fogg Creek Dam, 12°18'S, 131°16'E, 30.v.1974, *Jacobs 1771* (MEL 1505248, NSW). c. 12 miles NE. of Edith River Siding, 9.iii.1965, *Lazarides & Adams 122* (CANB 160506, NT 39416).

*Queensland*—About 40 km from Normanton on the Croydon road, c. 17°55'S, 141°20'E, 19.iv.1975, *Craven 3308 A* (CANB; MEL 1519900). Corinda, 17°53'S, 138°35'E, 6.v.1974, *Jacobs 1484* (MEL 565162, NSW).

#### DISTRIBUTION:

Typical populations occur in the Northern Territory from the Darwin to Mary River region south to the Daly River and Katherine, with an eastern record from the vicinity of the East Alligator River. Six populations from areas south of the Gulf of Carpentaria, from the Arnold River, Northern Territory, to the Normanston/Croydon region, Queensland, are somewhat different from the typical. *Kenneally 2193* from West Kimberley, Western Australia, agrees with those from the Gulf country. Six other widespread Kimberley collections are at present only doubtfully referable to *N. quadriloba*. See under notes, also seed descriptions.

#### HABITAT:

Lagoon edges and ephemeral swamps, in still shallow freshwaters; once recorded from irrigation channels of rice bays and once from clear, slow-flowing water

in a creek. On sand and sandy-humus substrates; rarely grey mud or grey clay. Flowers and fruits well in water 5-50 cm deep and where stranded on saturated soil. Fl. and Fr. recorded 31 January – 20 July, with one record 1 September.

#### NOTES:

Readily recognised as a member of the “indica group” by the white/pale pink/pale mauve flowers (yellow only in the throat) and the clustered inflorescence arising from the apparent petiole close against the leaf blade. It differs from all other species of that group in having keeled corolla lobes and in the characteristic seed of typical populations. The mostly 4-partite flowers, the deeply lacinate margins of the corolla-lobe wings and keel, the varied leaf shape with convex basal sinus and, when present, the pale pink or mauve colour of the corolla are also important characters.

The epithet *quadriloba* refers to the four-lobed corolla which is very noticeable in the field.

Corolla colour varies between and within populations and there is sometimes intergrading of colours on the same flower. Corollas of *Aston 1944* were wholly white except for the yellow throat, while those of the paratype population were “very pale pink grading to deeper mauve-pink at base of lobes and upper throat; yellow in the throat. Occasionally the deeper mauve-pink absent and corolla then very very pale pink (or almost white) with yellow throat”.

In edge view the seed of typical populations from the Northern Territory is top-shaped and distinctive. That of Carpentaria populations (see distribution, also seed descriptions) is broadly and evenly biconvex in cross-section and, together with the larger caruncle, often similar to seed of *N. spongiosa*. There is some gradation between the two seed types of *N. quadriloba* and the regional distinction may prove more apparent than real when further fully-adequate collections are available.

Several collections from the Kimberleys which have seeds with more clustered, dome-based tubercles possibly belong to *N. quadriloba* but material seen is inadequate for conclusions.

#### *Nymphoides spongiosa* H. I. Aston, sp. nov.

*Nymphoides* sp. nov. “M”, Aston in litt.

Plantae annuae. Laminae foliorum ellipticae-oblongae ad late ovatae, integrae, profunde cordatae, (1-)2-5.5 x (0.8-)1.5-4.5 cm, infra spongiosae sed laeves (haud rugosae). Inflorescentia fasciculus pedicellorum densus, ad basin sinus folii ortus. Flores heterostyli, (4)5(6)-partiti. Corolla (7-)10-18(-20) mm diametro, alba, fauce flavo; lobae late ellipticae, alis lateralibus undulatis integris, fimbriaque transversa proxime super basin lobae papillarum tenuium formata, praeditae. Ovarium  $\pm$  globosum, in stylam abrupte contractum. Capsula latissime ellipsoidea ad  $\pm$  globosa, 2.25-4 x 1.75-3 mm. Semina (5-)8-14(-25) per capsulam,  $\pm$  globosa, parce compressa, tuberculis convexis brevissimis dense velata (vel tubercula nonnisi in marginibus seminum) 0.65-1.1 x 0.6-0.97 x 0.35-0.7 mm (longitudo latitudinem aequans, crassitie sesquialongior ad duplongior), straminea ad pallide cinereo-fusca maturitate; caruncula basalis, circularis, typice crassa conspicuaque.

Apparently annual. *Petiole-like stems* few to many, arising from the plant base, slender, flexuose, 3 cm (plants on mud) to 90 cm (plants in water) long x 1 mm or less diam.; true petiole minute or apparently absent. *Leaf blades* elliptic-oblong to broad-ovate in outline, deeply cordate (the lobes mostly (30-)40-50% of the total blade length and separated by a sinus of 40°-70°(-90° angle), obtuse, entire, (1-)2-5.5 x (0.8-)1.5-4.5 cm, green and shining above, white-translucent and spongy beneath; spongy tissue thickest at the centre and grading to thin or absent at the blade edges, smooth-surfaced, not rugose. *Inflorescence* as for the “indica group”; pedicels subtended by  $\pm$  ovate, membranous, translucent bracts 3-6 mm long. *Pedicels* (10-)12-30, emerging erect through the sinus when in flower, very slender, (8-)14-40 x < 0.5 mm. *Flowers* (4)5(6)-partite. *Calyx lobes* lanceolate, acute, membranous, mostly purplish-translucent, usually slightly outcurved at the apex particularly in fruit. *Corolla* (7-)10-18(-20) mm span, white with a yellow throat. *Corolla lobes* broad-elliptic; mid-section glabrous except for a conspicuous transverse fringe of fine papillae just above its base; side-wings broad, undulate, entire (1-few

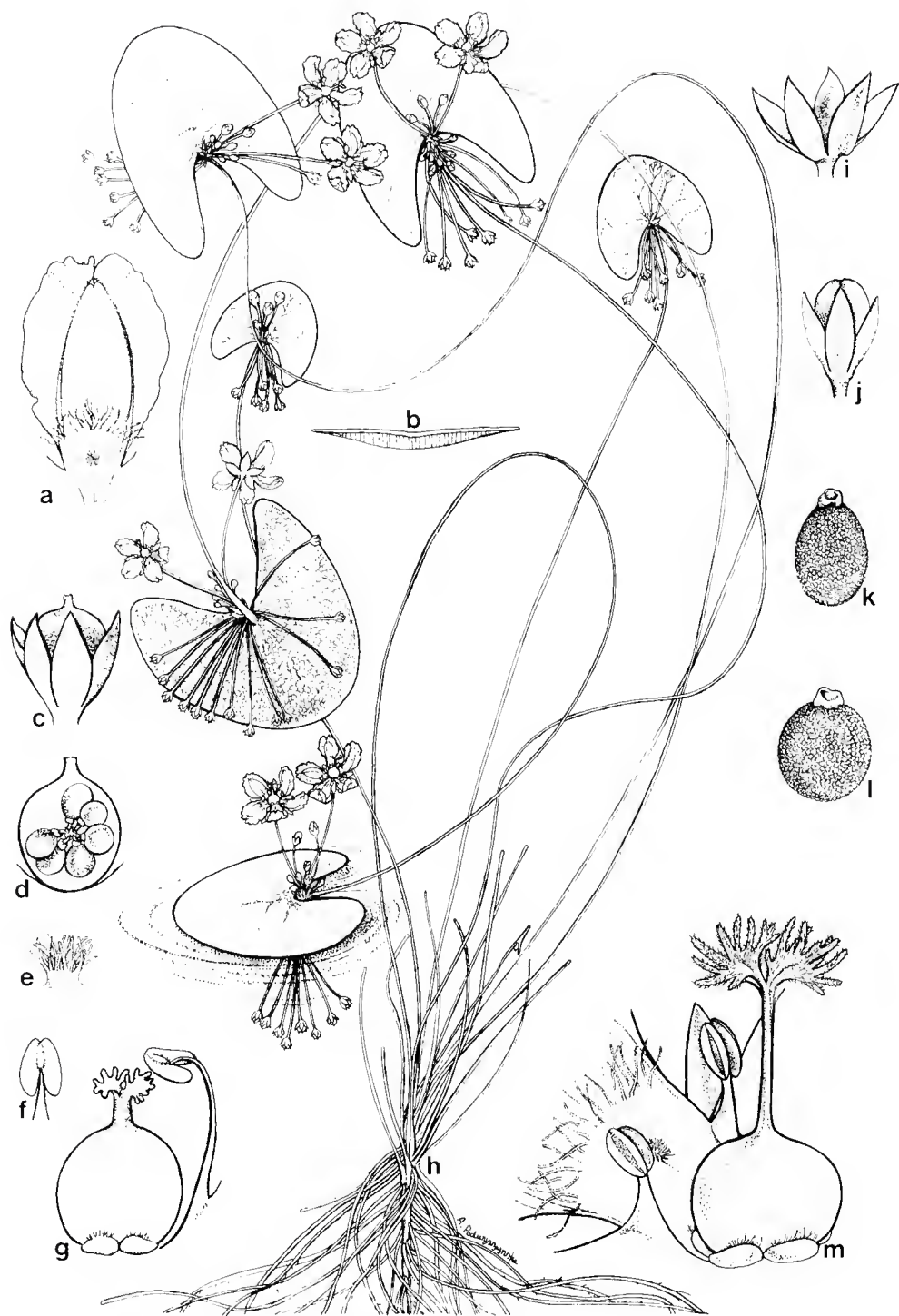


Fig. 4. *Nymphaoides spongiosa*. a—portion of corolla, x 4.5; b—leaf, T.S. showing spongy underside, x 1; c—capsule and persistent calyx, x 5; d—capsule, L.S. showing the position of one of the short placentas, x 5; e—cluster of papillae from corolla tube, x 25; f—anther, dorsal view, showing connective and versatile attachment, x 14; g—portion of short-styled flower showing relative positions of stamen and gynoecium, x 14; h—habit, x 0.7; i—calyx, x 5; j—bud, x 6; k—seed, edge view, x 14; l—seed, face view, x 14; m—portion of long-styled flower, x 14. a, e—g, and m from Aston 1903 (MEL); b—d, and h—j from Aston 1936 (MEL); k—l from Must 1123 (BRI).



lacinae at the apex), extending from the apex of the lobe almost to its base. *Corolla tube* papillae clustered at the summit of a short common stalk. *Stamens* with filaments c. 0.3-0.6 and 1-2.4 mm long in long-styled and short-styled flowers respectively, strongly incurved above the stigma in short-styled flowers; anthers versatile,  $\pm$  broad-linear to elliptic, c. 1.5 times as long as broad, c. 0.5-0.7 mm long. *Gynoecium (long-styled flower)* c. 3-3.2 mm long; ovary  $\pm$  globose, abruptly contracted into the style; placentas 2(-3), very short, less than one-quarter of the capsule length, positioned centrally down the ovary wall; ovules c. (5-)11-28(-37); style c. 0.8-1.5 mm long; stigmas 2(-3), each a broad, papillate, irregularly-shaped, usually strongly lacinate, semi-spreading wing c. 0.7 mm long. *Gynoecium (short-styled flower)* c. 1.5 mm long; style c. 0.2-0.45 mm long; stigmas c. 0.2-0.5 mm long, condensed, rather lobed and undulate. *Capsule* very broad-ellipsoid to globose, from a little less than to equal to the calyx, 2.25-4 x 1.75-3 mm. *Seeds* (5-)8-14(-25) per capsule; body of seed very broad-ellipsoid, near-globose but slightly to moderately laterally compressed, 0.65-1.11 mm long x 0.6-0.97 mm wide x 0.35-0.7 mm thick, cream-straw to light brown-grey when mature, densely covered with very short convex tubercles or else having the faces smooth with the tubercles present only on and close to the seed edges and gradually diminishing in length from the edge towards the face; basal caruncle present, circular, pale, typically thick and conspicuous, sometimes thin. (Seeds of many capsules are shallowly pitted, the pits consisting of incipient tubercles not yet extruded. It is often difficult to locate capsules with seeds showing the maximum degree of tubercle development for the population concerned.)

#### TYPE COLLECTION:

About 6 km east of the Howard River crossing of the Howard Springs to "Koolpinyah" road, 12°26'S, 131°08'E, Northern Territory, 17.v.1976, *Aston 1936* (Holotype: MEL 1505146. Isotypes: CANB, MEL 1505145, NT).

#### SELECTED SPECIMENS EXAMINED (total 14):

*Northern Territory*—c. 2 km NE. of the Jim Jim Creek crossing of the Pine Creek to Oenpelli road, 12°57'S, 132°34'E, 9.v.1976, *Aston 1903* (MEL 1505142-43, NSW, NT). Yellow Waterhole at Jim Jim (=Cooinda) Camp, 12°55'S, 132°32'E, 9.v.1976, *Aston 1905* (BR1, MEL 1505144). Georgetown Waterhole, on the Magela Creek system, c. 6 km SE. of Jabiru, 12°42'S, 132°56'E, 10.v.1976, *Aston 1912* (K, MEL 1505147-49, NSW). Lagoon near South Alligator River, 12°56'S, 132°24'E, 4.vii.1977, *Craven 4593* (CANB 271633, MEL 537853, NT 56386). Overflow of "Mudginbarry" Lagoon, 12°35'S, 132°52'E, 1.vi.1974, *Jacobs 1801*(NSW). Nourlangie Rock area, 23.v.1973, *Must 1123* (BR1 169980, CANB 244197, DNA 6806, NT 41699).

#### DISTRIBUTION:

*Northern Territory*—Prolific in the Jim Jim Creek—Nourlangie—Jabiru—Mudginbarry region between the South and East Alligator Rivers and also recorded from the Howard River—Koolpinyah area east of Darwin.

#### HABITAT:

Seasonal swamps, lagoons and backwaters of creeks, in still shallow freshwaters. On sandy-humus, sandy-mud and heavy clay substrates. Flowers and fruits well in water 5-60 cm deep and where stranded on saturated soil. Fl. and Fr. recorded 8 April—21 July, with one collection in November.

#### NOTES:

Readily recognised as a member of the "indica group" by the white flowers (yellow only in the throat) and the clustered inflorescence arising from the apparent petiole against the leaf blade. It differs from all other species of that group in its spongy but smooth underleaf surface and in its corolla lobes (side-wings entire, broad, extensive). The mostly 5-partite flowers, the lack of keels on the corolla lobes, the  $\pm$  globose ovary abruptly contracted into the style, the shortness and position of the placentas and the seed characters should also be noted.



The epithet *spongiosa* refers to the leaf sponginess which is very noticeable in the field and also discernible in dried collections.

**Nymphoides subacuta** H. I. Aston, sp. nov.

*Nymphoides* sp. nov. 'D', Aston in litt.

Plantae annuae vel ?perennes. Laminae foliorum angustissime ad late ovatae, aliquando quasi-circulares, integrae, profunde cordatae, acutae vel late obtusae, (1-)3-11 x (0.5-)2-9 cm. Petiolus compressus, in sectione oblongus. Inflorescentia laxa, binis floribus pedicellatis binisque bracteis ad nodos; internodis 0.2-5(-9) cm longis. Flores heterostyli, (4)5(6)-partiti. Calyx projecturis labiformibus, incrassatis minutis ad loborum juncturas praeditus. Corolla (20-)26-40(-45) mm diametro, flavo-aurantiaca; lobae alis lateralibus latis perlaciniatis fimbriaque transversa prope lobae basin papillarum tenuium liberarum formata praeditae. Papillae liberae, vel in fasuculis ad basin incrassatis semi-connatae, in medium marginemque fimbriam. Capsula ellipsoidea-ovoidea, 3-6 x 2.5-4 mm. Semina 2-8 per capsulam,  $\pm$  globosa, leviter autem compressa, 1.4-1.9 x 1.3-1.7 x 1-1.4 mm (longitudo latitudinem aequans, crassitie  $1\frac{1}{3}$ - $1\frac{1}{2}$  longior), nigrescentia-atrofusca maturitate, tholiformibus-projecturis velata; tholi de tuberculis tenuibus obtusis densi-appressis formati; depressiones inter tholis tuberculis similaribus brevioribus vestitae; caruncula basalis, circularis, pallida, crassa, conspicua.

Annual, perhaps perennial where water persists. *Branches* several from the plant base, slender, flexuose, floating, simple or forked once or twice, to 70 cm long, their terminal portions developing the inflorescences. *Basal leaves* several; petioles slender, compressed, oblong in cross-section, to 75 cm long; blades narrow- to broad-ovate or occasionally near-rounded in outline, deeply cordate (the lobes mostly 30-40% of the total blade length and separated by a sinus of 12°-40° (-60°) angle or rarely slightly overlapping), acute to broad-obtuse, entire, (1-)3-11 x (0.5-)2-9 cm. *Cauline leaves* similar, becoming progressively smaller and shorter-petioled toward the inflorescence. *Inflorescence* as for the "geminata group", the internodes 2-50(-90) mm long; bracts lanceolate-ovate, c. 2-7 mm long, one bract of the lower node often replaced by a leaf; pedicles 20-70(-100) mm long. *Flowers* (4)5(6)-partite. *Calyx lobes* narrow-ovate, (3.5-)5-6 mm long, thick-textured with narrow translucent margins and basally with a minute, thickened, lip-like projection formed at each junction of contiguous lobes. *Corolla* (20-)26-40(-45) mm span, "orange-yellow" to "deep bright golden-orange". *Corolla lobes* broad-elliptic; mid-section glabrous except for a conspicuous transverse fringe of fine papillae at its base and sometimes a few papillae along its midline above the fringe; fringe papillae c. 1-2.5 mm long, all free or else some partially-united to form thick-based clusters of shorter (sometimes hair-tipped) papillae, the clusters 1-several at the edges and centre of the fringe; side-wings broad, undulate, strongly-laciniate, extending from the apex of the lobe almost to the base. *Corolla tube* papillae free within the cluster and sessile, or else arising from a common stalk. *Stamens* with filaments c. 0.3 and 1.3 mm long in long-styled and short-styled flowers respectively; anthers  $\pm$  linear-ovate, c. 1.5-2 times as long as broad, 1.5-1.75 mm long. *Gynoecium (long-styled flower)* c. 7.5 mm long; ovary free except at the base,  $\pm$  linear-conical, gradually tapered into the style; placentas 2, short, extending down perhaps one-quarter of the length of the ovary wall; ovules c. 10; style c. 1.5 mm long; stigmas 2, each a broad, lobed, papillate,  $\pm$  semicircular, erect wing c. 3 x 3.5 mm, the lobes sometimes deep-cut and undulate and simulating additional stigmas. *Gynoecium (short-styled flower)* c. 3.5 mm long, style c. 0.75 mm long; stigmas c. 1.25 x 1.8 mm, condensed, deeply-lobed and undulate thus obscuring the basic wings. *Capsule* ellipsoid-ovoid, equal to or a little longer than the calyx, 3-6 x 2.5-4 mm, opening irregularly underwater or sometimes (on plants stranded on mud) becoming dry and chartaceous and splitting at the summit into usually 4 recurved valves. *Seeds* 2-8 per capsule; body of seed  $\pm$  globose but slightly laterally compressed, 1.4-1.9 mm long x 1.3-1.7 mm wide x 1.1-1.4 mm broad, dark brown-grey-black when mature, covered with regular dome-like projections, each dome consisting of closely-appressed slender obtuse tubercles, the inter-dome depressions densely covered with shorter non-appressed but otherwise similar tubercles; basal caruncle present, circular, pale, thick and conspicuous.

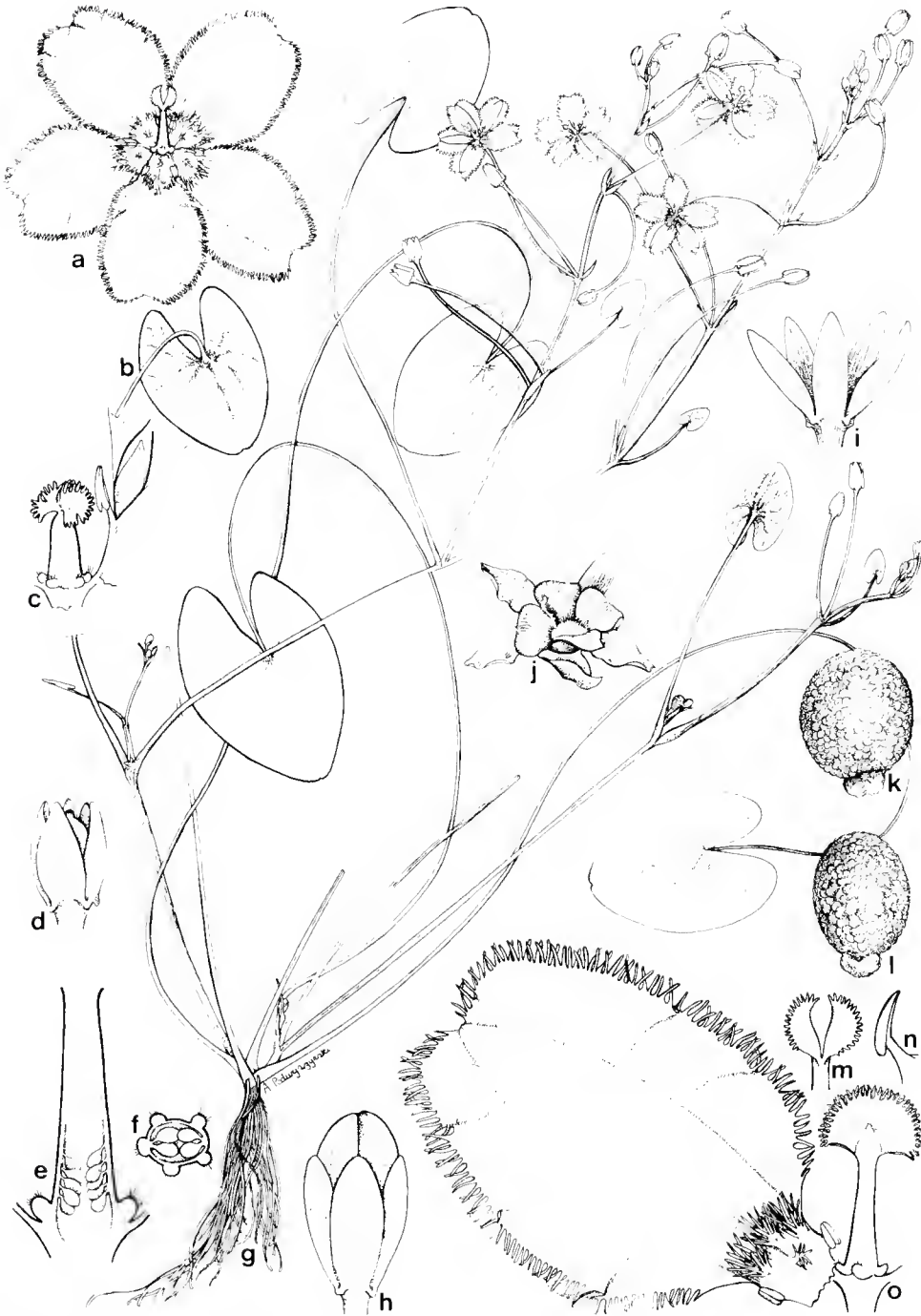


Fig. 5. *Nymphoides subacuta*. a—flower, long-styled, x 1.5; b—leaf undersurface, x 0.3; c—portion of short-styled flower, x 4; d—calyx, showing basal projections, and enclosing a semi-mature capsule, x 2; e—ovary, L.S. showing its partially-inferior structure and short parietal placentas, x 8; f—ovary, transverse section, x 8; g—habit, x 0.3; h—bud, x 3.5; i—calyx, showing basal projections, x 2; j—dehiscent capsule from plant stranded on mud, the valves recurved, calyx persistent but spread, x 2.5; k—seed, face view, x 12; l—seed, edge view, x 12; m—stigma from long-styled flower, edge view, x 4; n—stamen, lateral view, x 7; o—portion of long-styled flower, x 4. All from Aston 1935 (MEL).

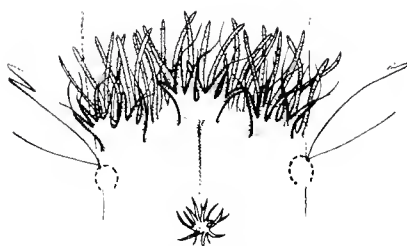


Fig. 6. *Nymphoides subacuta*. Papillate fringe of the corolla lobe, semi-diagrammatic, showing some clustering, x 8. From Aston 1935 (MEL).

#### TYPE COLLECTION:

McMinns Lagoon, approximately 30 km ESE. of Darwin city centre, 12°31'S, 131°05'E, Northern Territory, 20.v.1976, *Aston 1954* (Holotype: Long-styled plant 1954A (MEL 1505123). Isotype: CANB. Paratypes: Short-styled plant 1954B (DNA); Short-styled plant 1954C (MEL 1505122 and 124); Style unspecified, leaves only, showing variation (MEL 1505125). All plants of *Aston 1954* collected within 3 metres of each other.

#### SELECTED SPECIMENS EXAMINED (total 12):

*Northern Territory*—Lagoon 10 miles from Darwin, v. 1922, *Allen 539* (NSW). Adelaide River, 1890, *Anonymous 1117* (MEL 1505126-28). Point Stuart road, 11 km south of Jimmys Creek, 12°39'S, 131°48'E, 13.v.1976, *Aston 1930*, (CANB, K, MEL 1505119-21). Knuckey's Lagoon, 12°27'S, 130°57'E, 17.v.1976, *Aston 1935* (CANB, MEL 1505109 and 111-115, NSW, NT). Scotch Creek, 12°41'S, 131°28'E, 19.v.1976, *Aston 1948* (DNA, MEL 1505116). Point Stuart, [12°15'S, 131°55'E], 5.v.1967, *Byrnes 265* or *265a* (AD 96942177, DNA 1070, NT 14169). Port Darwin, 1885, *M. Holtze 485* (MEL 1505130). Koongarra, 12°53'S, 132°50'E, 19.iv. 1979, *Rankin 2030* (MEL 558461! DNA n.v.).

#### DISTRIBUTION:

*Northern Territory*—recorded only from the region between Darwin and the East Alligator River. Frequent from near Darwin east to Jimmy's Creek and Point Stuart, with one outlying record from south-east of Nourlangie Rock.

#### HABITAT:

Seasonally flooded still, shallow, freshwater swamps, backwaters, or roadside depressions; once recorded from a permanent lagoon. On sandy, sandy-loam or sandy-humic substrate; once recorded from black soil plain. Flowers and fruits well in water 2-50 cm deep and where stranded on saturated soil. Fl. and Fr. recorded 19 April—18 July.

#### NOTES:

Readily recognised as a member of the "geminata group" by the yellow-orange flowers and open inflorescence with twinned pedicels. It differs from all other species of that group in its more pointed leaf blades, its compressed petioles, the presence of the small protruberances at the junctions of the calyx lobes and in the very distinctive seeds.

The epithet *subacuta* refers to the comparatively pointed and sometimes quite acute apex of the leaf blades. This feature is conspicuous in the field and allows at least tentative identification of a population of the species at first glance.

Individuals (*Aston 1930*) from only 2-7 cm water in a temporarily-flooded tabledrain exhibited the smallest, most acute leaves of any plants seen. Many blades were only 1-2 cm long (maximum 3.5 cm) whereas those on a nearby plant from 20 cm water were 3.5-7 cm long. In *Aston 1935* the corolla span of both long- and short-styled flowers on stranded plants was (20-)28-32(-35) mm while that of flowers developed on adjacent plants in water was (28-)32-40(-45) mm. These examples illustrate the reduction in size of both vegetative and floral parts where they develop

in very shallow water or on plants stranded on saturated soil. This reduction is noticeable in *Nymphoides* species as well as in other aquatic genera.

#### ACKNOWLEDGEMENTS

Mr C. R. Dunlop, Darwin Herbarium, Department of Primary Production, Darwin, and Mr B. P. M. Hyland, Queensland Research Station, CSIRO, Atherton, provided invaluable assistance and support during my field work on *Nymphoides* in 1976 in the Northern Territory and Queensland respectively. Mr L. G. Adams, Herbarium Australiense, CSIRO, Canberra, provided material of *N. quadriloba* with the suggestion that it could be a new species and directed me to what is now its type location. Mr L. A. Craven, also of Herbarium Australiense, has been consistently helpful over several years in gathering good collections from the Northern Territory and in alerting me to the presence of *N. planosperma*. Messrs N. T. Sanderson and J. T. Waterhouse, School of Botany, University of New South Wales, Sydney, have forwarded their own collections and field notes, those of *N. planosperma* being particularly appreciated because of the few collections yet made of this species. Drs B. R. Jackes (JCT), S. W. L. Jacobs (NSW) and R. C. Carolin (SYD) have all made special collections for my examination. Dr. G. A. M. Scott, Botany Department, Monash University, Melbourne, has kindly prepared all latin descriptions and Miss A. Podwyszynski of the National Herbarium of Victoria has provided the illustrations. I am very grateful to all these people for the great assistance they have given.

Full acknowledgement to herbaria for the loan of specimens and the use of facilities will be given in the subsequent generic revision.

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# VEGETATION OF EAST GIPPSLAND

by

S. J. FORBES, N. G. WALSH AND P. K. GULLAN\*

## ABSTRACT

East Gippsland, Victoria, was surveyed between June 1979 and May 1980, employing a floristics-based, quadrat-sampling technique. Data from 590 quadrat sites were analysed via a computer-based, numerical sorting and classification procedure to determine the major floristic vegetation types within the area. These types were then arranged into 21 floristic 'communities', each of which is comprised of one or more floristically distinct 'sub-communities'. The sub-communities and their distribution are outlined in this paper, and include alpine and coastal heathlands, montane and lowland closed-forest, open-forests and saltmarsh vegetation.

## INTRODUCTION

This paper presents the results of a vegetation survey of East Gippsland. Its purpose is to define and describe the major floristic vegetation types of the study area, and to outline the distribution and environmental range of each.

## THE STUDY AREA

East Gippsland is defined as all land in Victoria east of 148°00'00"E (fig. 1a) (Leeper, 1969). This definition was adopted for the present survey, but with the exclusion of land north of 36°35'00"S. Major topographical features include the Cobberas (north-west), the Nunniong Plateau (west), the Errinundra Plateau (central) and Mt. Tingaringy (north-central). The highest peak is Mt. Cobberas No. 1 (1820m.) and is situated on the Great Dividing Range. The upper Murray River catchment is enclosed north of the Divide, whilst major rivers south of the Divide are (from west to east): the Snowy, Bemm, Cann, Thurra, Mueller, Wingan and Genoa Rivers (figure 1b). Of these only the Genoa and Snowy Rivers have any of their catchment outside the study area. The Snowy River is dammed at Lake Jindabyne in N.S.W. to supply water to a major hydro-electric scheme.

The study area is approximately 1,360,000 hectares (about 5.5% of Victoria), of which about 85% is public land. The main controlling authorities for this land are the Forests Commission, the National Parks Service and the Department of Crown Lands and Survey (L.C.C., 1977). The remaining 15% is private land, about two-thirds of which has been cleared for agriculture (mostly grazing). Orbost is the largest town and is surrounded by the most extensive farmlands of the study area. Other agricultural regions include the Buchan district, the area north of Buchan through Gelantipy to the Wulgulmerang Plateau, the Deddick River valley, Bonang, Bendock and the Cann River valley north of Cann River.

## THE SURVEY

### Method

#### FIELD WORK

The procedure followed was the same as outlined in Gullan *et al.* (1981). Four sites, each approximately 1000m<sup>2</sup>, were sampled within a rectangle of 5 minutes latitude and 5 minutes longitude. Each site sampled constituted a single uniform habitat, and was, where possible, environmentally distinct from each other site within the rectangle. Sampling intensity was occasionally increased in rectangles with a wide diversity of vegetation types.

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*Muelleria* 5(1): 53-113 (1982).

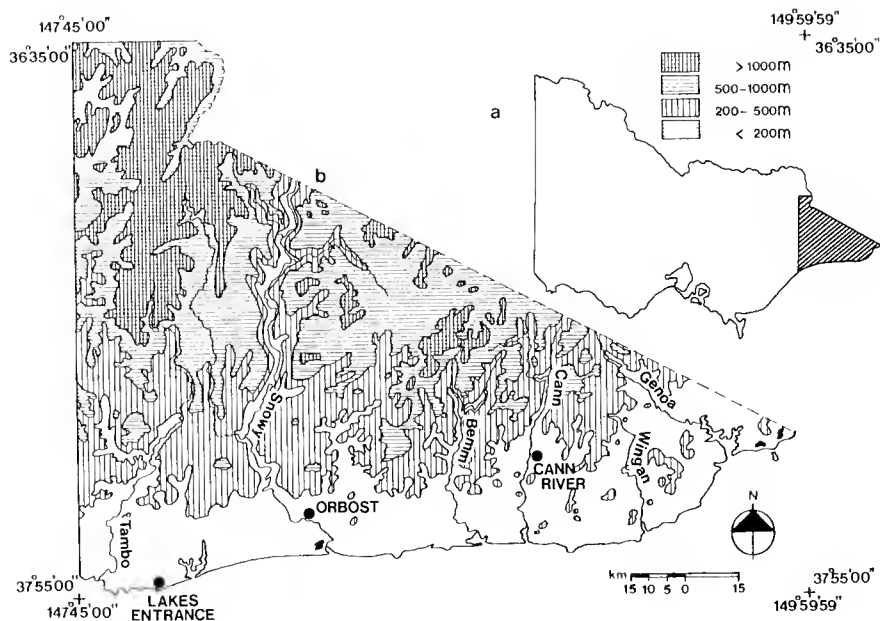


Fig. 1. a—Location of the study area. Hatching represents the area actually sampled. b—The study area. Different hatching represents different altitude ranges.

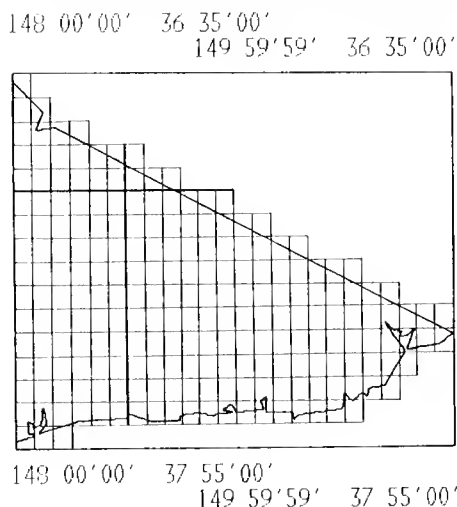


Fig. 2. The 5' latitude x 5' longitude grid system superimposed on a map of the study area.

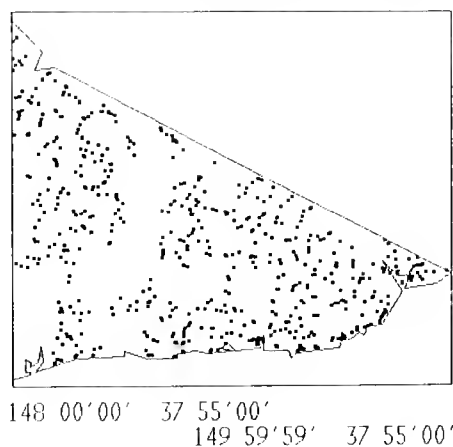


Fig. 3. Distribution of sample sites within the study area.

The study area included 194 rectangles (fig. 2), of which 158 were sampled with a total of 590 sites (fig. 3). The remaining 36 rectangles were not sampled due to inaccessibility and time constraints.

Data were collected during 9 field trips, each of 12 days duration. Each trip has been allotted an identifier from 12 (first trip) to 20 (last trip). Sample sites on each trip were numbered sequentially. Thus site 14049 indicates site 049 of trip 14. The base camps for each trip were as follows:

- |                   |                |                  |
|-------------------|----------------|------------------|
| 12. Croajingalong | 15. Deddick    | 18. Gelantipy    |
| 13. Marlo         | 16. Errinundra | 19. Cobberas     |
| 14. Orbost        | 17. Mallacoota | 20. Coopracambra |

## PLANT IDENTIFICATION

Where possible, all species were identified and recorded on site. Material that required more thorough examination and comparison with reference material was collected and identified at the National Herbarium. Nomenclature follows that of Willis (1970, 1972) with amendments by Todd (1979). The determination of certain suites of species posed particular difficulties, and for these nomenclatural qualifications have been made. These groups are outlined here but for further discussion of the taxonomic difficulties see Gullan *et al.* (1981):

*Eucalyptus rubida* and *E. dalrympleana*—were recorded as *E. rubida*  
*Geranium potentilloides*, *G. solanderi* and *G. retrorsum* (where non-fertile)—recorded as *G. potentilloides*  
*Gnaphalium spicatum* and *Gamochaeta purpurea*—recorded as *G. spicatum*  
*Hydrocotyle hirta*, *H. laxiflora* and *H. algida* (where non-fertile)—recorded as *H. hirta*  
*Juncus* spp. (sect. *Genuini*)—recorded as *Juncus* spp.  
*Luzula* spp.—recorded as *L. campestris* spp. agg.  
*Plantago varia* group—recorded as *P. varia*  
*Poa australis* group—recorded as *P. australis* spp. agg.  
*Ranunculus lappaceus* and *R. pachycarpus* (where non-fertile)—recorded as *R. lappaceus*  
*Rubus fruticosus* group—recorded as *R. fruticosus* spp. agg.

## DATA STORAGE AND ANALYSIS

Information from each site (floristics, locality, altitude and sampling date) was stored permanently on magnetic disk. These data were assessed and manipulated via a numerical, classificatory computer program. Presentation of the analysis was by two-way tables which were successively refined using a hand-sorting procedure (Gullan, 1978).

In excess of 1000 species of vascular plant were recorded during the study. Only a portion of these are presented on two-way tables, as most species occur in less than 10% of sites, and add little to the overall vegetation description. (for full explanation of the two-way tables see Gullan *et al.* 1981).

## Terminology

Terminology associated with the vegetation classification follows that of Gullan *et al.* (1981). Specific terms are discussed briefly here.

**SUB-COMMUNITY**—is a group of sample sites which have a similar floristic composition (= "nodum" Poore, 1955). It is the basic unit of vegetation used in this paper.

**COMMUNITY**—is one or more sub-communities which have floristic and environmental affinities. The community may represent a floristic continuum along which arbitrary divisions have been made to form sub-communities. It may also represent a collection of sub-communities which are considered to be temporal phases of one vegetation after different disturbances (e.g. fire, grazing).

**CHARACTER SPECIES**—are determined as follows:

where  $F$  = frequency of species in a sub-community and

$Q$  = number of sample sites in the sub-community,

if  $Q \leq 10$ , then those species where  $F > 55\%$  are characteristic

if  $Q \geq 50$ , then those species where  $F > 35\%$  are characteristic

if  $Q > 10$  or  $< 50$ , then those species where  $F > \text{or} = (55 - (Q - 10)/2)\%$  are characteristic.

This definition is explained further in Gullan *et al.* (1981). Standard use of the term is detailed in Mueller-Dombois & Ellenberg (1974).

**COMMUNITY NAMES**—have been designed to convey, in commonly used terminology, an impression of the vegetation. Where appropriate the same community names as in Gullan *et al.* (1981) have been applied (e.g. Wet Sclerophyll Forest, Montane Sclerophyll Woodland).

**OPPORTUNISTIC SPECIES**—are those species whose cover value increases dramatically as a result of disturbance. Shrubs, especially members of the Papilionaceae (c.g. *Pultenaea* spp., *Daviesia* spp.) and Asteraceae (*Cassinia* spp., *Olearia* spp.) and many herbs (*Tetrarrhena juncea*, *Senecio* spp.) commonly exhibit this characteristic. The cover value of such species is usually low in undisturbed forest, but may be as great as 100% after disturbance. Fire, forestry operations and clearing for agriculture are the main agents of this disturbance.

## Limitations and Qualifications

### FLORISTICS

As each quadrat was sampled only once, ephemeral species were often not in evidence (see previous remarks on Plant Identification).

### DISTRIBUTION OF VEGETATION TYPES

The distribution maps provided in the RESULTS section show sites where a sub-community is present. They should not be interpreted as vegetation maps.

### WEED PROBLEM

Substantially native vegetation was always chosen for quadrat sites. Thus the index of introduced species generally understates the weed problem of a district.

## RESULTS

Information is displayed in an accessible form, viz.:

### Two-way Tables

Tables 1 to 6 present the salient information from the survey and show:

- the quadrats comprising each community and sub-community.
- the species characterising communities and sub-communities.
- the relationships and differences between communities and sub-communities.
- the variation within communities and sub-communities.
- the distribution of common, although generally not characteristic, species within communities.
- the cover-abundance of each species in each quadrat.

### Community Descriptions

Twenty-one communities, representing the major, extant vegetation types, are defined for East Gippsland. It is probable that other communities existed prior to the rather intensive utilisation of land in certain areas. Some communities (and almost certainly some sub-communities) of very restricted or isolated occurrence may not have been encountered during the study (e.g. the *Eucalyptus fraxinoides* dominated tall open-forests of the eastern Howe Range). Other vegetation may have been sampled with insufficient frequency to enable satisfactory delineation. The absence of 53 sites (out of 590 sites sampled) from the two-way tables is partly attributable to this factor. Sites of heavily disturbed vegetation also contribute to this deficit. Gross disturbance, usually as a result of forestry operations or recent fire, promotes a vegetation which is species-poor and consequently, impossible to accurately assign to a community.

The following is a brief description of each of the major communities:

**EG COMMUNITY 1:** Alpine Wet Heathlands (2 sub-communities; 19 sites).

Closed-heath to low woodlands of plains and damp depressions in the high country from the Cobberas to Mt. Bowen.

**EG COMMUNITY 2:** Montane Riparian Forest (1 sub-community; 5 sites).

Closed-scrub to open-forest along gullies and stream margins in the high country.



- EG COMMUNITY 3: Montane Forest (1 sub-community; 6 sites).  
Tall open-forest of sheltered sites in high country from the upper reaches of the Snowy River to the Cobberas.
- EG COMMUNITY 4: Snow Gum Woodlands (1 sub-community; 18 sites).  
Low woodland of subalpine ridges throughout the study area.
- EG COMMUNITY 5: Montane Sclerophyll Woodland (3 sub-communities; 29 sites).  
A woodland community typical of montane skeletal soils with low effective rainfall.
- EG COMMUNITY 6: (2 sites).  
Insufficient sites have been sampled to adequately describe this vegetation type. Field experience suggests this is a subalpine variant of sub-community EG 11.1. This subalpine rocky outcrop scrubland is characterised by the mallee-like *Eucalyptus glaucescens* and a closed shrub layer.
- EG COMMUNITY 7: Cool Temperate Rainforest (1 sub-community; 8 sites).  
Closed-forest of wet montane gullies and sheltered slopes within the area bounded by Bonang, Mt. Ellery and Mt. Coopracambra.
- EG COMMUNITY 8: Wet Sclerophyll Forest (4 sub-community; 52 sites).  
Tall open-forest of well-watered slopes of the eastern ranges, from near Mt. Bowen through to Mt. Coopracambra.
- EG COMMUNITY 9: Dry Sclerophyll Forest (4 sub-communities; 42 sites).  
Open-forest or woodland of foothills throughout the area.
- EG COMMUNITY 10: Box-Ironbark Woodland (1 sub-community; 10 sites).  
This woodland is typical of dry slopes and ridges with skeletal soils in lowland Victoria, but is of sporadic occurrence within the study area.
- EG COMMUNITY 11: Rocky Outcrop Open-scrubland (1 sub-community; 11 sites).  
This community has a diversity of sub-communities in the field. However, further sampling would be necessary to represent these adequately. Mallee forms of a number of eucalypts above a variable shrub layer are characteristic. Concentrated in the upper Snowy River area.
- EG COMMUNITY 12: Warm Temperate Rainforest (1 sub-community; 23 sites).  
Closed-forest of gully-heads and streamsides in lowland to foothill country. Rare to the west of the Snowy River but scattered throughout the remaining lowlands.
- EG COMMUNITY 13: Riparian Forest (3 sub-communities; 73 sites).  
Floristically rich, open-forest of wet slopes and riversides of all major waterways in the area. A tall shrub layer of mesophytic species is common within this community.
- EG COMMUNITY 14: Rain-shadow Woodland (3 sub-communities; 23 sites).  
A woodland of dry, gravelly sites of the north-east, especially in the vicinity of the Snowy River at the New South Wales border. *Eucalyptus albens* and *Callitris columellaris* are the common trees, but shrub and ground layer plants are sparsely distributed.
- EG COMMUNITY 15: Banksia Woodland (1 sub-community; 30 sites).  
Woodland scattered on coastal lowlands from the Snowy River to the Victoria-New South Wales border. Although inland from full oceanic influence, it rarely extends far from the coast.
- EG COMMUNITY 16: Lowland Sclerophyll Forest (5 sub-communities; 106 sites).  
Open-forest of coastal lowlands throughout the study area. It is the best represented community in East Gippsland.
- EG COMMUNITY 17: Coastal Heathland (4 sub-communities; 32 sites).  
Open- and closed-heathlands distributed throughout the damp, lowland plains to 20 km inland. *Xanthorrhoea hastilis* and *Casuarina*



*paludosa* dominate two distinct sub-communities which may form extensive, treeless stands.

EG COMMUNITY 18: Coastal Sclerophyll Forest (1 sub-community; 29 sites).

A mixed-eucalypt open-forest distributed throughout the low-land regions but at lower elevations than Community 15. Particularly well-developed around Mallacoota and Orbost districts.

EG COMMUNITY 19: Coastal Banksia Woodland (1 sub-community; 6 sites).

A woodland of wet, sheltered sites, fringing near coastal waters such as Ewing Marsh, Tamboon Inlet and other estuaries. Dense thickets of *Gahnia clarkei* and *Melaleuca ericifolia* are characteristic of this community.

EG COMMUNITY 20: Primary Dune Scrub (1 sub-community; 6 sites).

Primary dune or seacliff community containing sand-accreting grasses, herbs and low shrubs. Taller shrubs occur on the leeward slopes and swales.

EG COMMUNITY 21: Saltmarsh (1 sub-community; 3 sites).

A community generally dominated by the tussock-rush *Juncus kraussii*, fringing estuarine waters of Sydenham, Tamboon, Wingan and Mallacoota Inlets. Salt-tolerant samphire plants frequent in other saltmarsh communities (low shrubland) are less common but may contribute significantly to the species composition.

## Sub-community Summary Sheets

### DISTRIBUTION MAPS

A diagrammatic representation of the distribution of all sites sampled has been produced for each sub-community. The distribution of all its constituent sites has been superimposed on a map of the study area together with major rivers and features.

### CHARACTER SPECIES TABLES

In these tables, only those species which are characteristic of a sub-community are listed. The ranking of the species in these tables is in order of their frequencies in the sub-communities. These values are listed along with the average cover-abundance values of the species. This order allows ready assessment of individual sub-communities. The two-way table presentation however, enables the interrelationships between sub-communities and communities to be more easily interpreted.

### SUB-COMMUNITY DESCRIPTIONS AND ANNOTATIONS

A simple description outlining distribution, environment and any special features has been made for each sub-community. Included with these descriptions are details of altitude, vegetation structure, floristic richness and weed composition.

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| COMMUNITY                     | 7             | 1              | 2 | 3 | 4 |
|-------------------------------|---------------|----------------|---|---|---|
| SUB-COMMUNITY                 | 1             | 1              | 2 | 3 | 4 |
| <b>QUADRAT</b>                |               |                |   |   |   |
| <b>SPECIES</b>                |               |                |   |   |   |
| <i>Blechnum fluviatile</i>    | +1++1+1       | +              |   |   |   |
| <i>Polypodium venosum</i>     | +11 11+1      |                |   |   |   |
| <i>Asplenium bulbiferum</i>   | +11 21+2      | +              |   |   |   |
| <i>Fieldia australis</i>      | +11 21 12     |                |   |   |   |
| <i>Uncinia tenella</i>        | +1++11+       | +              |   |   |   |
| <i>Grammitis billardieri</i>  | +11++11++     | +              |   |   |   |
| <i>Atherosperma moschatum</i> | +44331+32     | 3311++         |   |   |   |
| <i>Acacia frutescens</i>      | +211 4 2      | 31+ 32         |   |   |   |
| <i>Prostanthera lasiantha</i> | + +++ 1       | + 31 1 11+     |   |   |   |
| <i>Australina muelleri</i>    | + 1 11+       | + 1 1 11       |   |   |   |
| <i>Tasmanian lanceolata</i>   | +1+2+2        | +2231+32122 12 |   |   |   |
| <i>Eucalyptus nitens</i>      | +11+12 222 12 | 211            |   |   |   |

Table 2. Two-way table of Communities 7 and 8.

| COMMUNITY                     | 7             | 1              | 2 | 3 | 4 |
|-------------------------------|---------------|----------------|---|---|---|
| SUB-COMMUNITY                 | 1             | 1              | 2 | 3 | 4 |
| <b>QUADRAT</b>                |               |                |   |   |   |
| <b>SPECIES</b>                |               |                |   |   |   |
| <i>Blechnum fluviatile</i>    | +1++1+1       | +              |   |   |   |
| <i>Polypodium venosum</i>     | +11 11+1      |                |   |   |   |
| <i>Asplenium bulbiferum</i>   | +11 21+2      | +              |   |   |   |
| <i>Fieldia australis</i>      | +11 21 12     |                |   |   |   |
| <i>Uncinia tenella</i>        | +1++11+       | +              |   |   |   |
| <i>Grammitis billardieri</i>  | +11++11++     | +              |   |   |   |
| <i>Atherosperma moschatum</i> | +44331+32     | 3311++         |   |   |   |
| <i>Acacia frutescens</i>      | +211 4 2      | 31+ 32         |   |   |   |
| <i>Prostanthera lasiantha</i> | + +++ 1       | + 31 1 11+     |   |   |   |
| <i>Australina muelleri</i>    | + 1 11+       | + 1 1 11       |   |   |   |
| <i>Tasmanian lanceolata</i>   | +1+2+2        | +2231+32122 12 |   |   |   |
| <i>Eucalyptus nitens</i>      | +11+12 222 12 | 211            |   |   |   |

*Helictesum leucostichum*  
*Eucalyptus mannifera*  
*Pteridium esculentum*  
*Empodisma xiphocladia*  
*Persoonia chamaepeuce*  
*Eucalyptus dives*  
*Dirichia bhe micrantha*  
*Epacris impressa*  
*Monotoca scoparia*  
*Tetralix baueri*  
*Danthonia pallida*  
*Brachylaena daphnoides*  
*Excavatus strictus*  
*Acetaria stricta*  
*Centaurium pulchellum*  
*Dianella revoluta*  
*Hibbertia obtusifolia*  
*Hypericum gramineum*  
*Platylobium formosum*  
*Themeda australis*  
*Eucalyptus macrorhyncha*  
*Acacia obliqua*  
*Daviesia mimosoides*  
*Eucalyptus glaucescens*  
*Grevillea victoriae*  
*Phellipticum ozothymoides*  
*Veronica perfoliata*

*Blechnum fluviatile*  
*Polypodium venosum*  
*Asplenium bulbiferum*  
*Fieldia australis*  
*Uncinia tenella*  
*Grammitis billardieri*  
*Atherosperma moschatum*  
*Acacia frutescens*  
*Prostanthera lasiantha*  
*Australina muelleri*  
*Tasmanian lanceolata*  
*Eucalyptus nitens*





Table 3. Two-way table of Communities 9, 10 and 11.

| COMMUNITY                      | 9 | 10 | 11 |
|--------------------------------|---|----|----|
| SUB-COMMUNITY                  | 1 | 2  | 3  |
| QUADRAT                        | 1 | 2  | 3  |
| SPECIES                        | 1 | 2  | 3  |
| <i>Coprosma quadrifida</i>     | 1 | 1  | 1  |
| <i>Veronica calycina</i>       | 1 | 1  | 1  |
| <i>Acetia dealbata</i>         | 1 | 1  | 1  |
| <i>Glycine clandestina</i>     | 1 | 1  | 1  |
| <i>Tetradlea kauaefolia</i>    | 1 | 1  | 1  |
| <i>Plumbago lasiantha</i>      | 1 | 1  | 1  |
| <i>Poliochloa juncea</i>       | 1 | 1  | 1  |
| <i>Stellaria juncea</i>        | 1 | 1  | 1  |
| <i>Senecio quadridentatus</i>  | 1 | 1  | 1  |
| <i>Acrotriche prostrata</i>    | 1 | 1  | 1  |
| <i>Lucalyptus dives</i>        | 1 | 1  | 1  |
| <i>Indigofera australis</i>    | 1 | 1  | 1  |
| <i>Acrotriche serotina</i>     | 1 | 1  | 1  |
| <i>Asplenium humilis</i>       | 1 | 1  | 1  |
| <i>Gonocarpus tetragynus</i>   | 1 | 1  | 1  |
| <i>Hardenbergia violacea</i>   | 1 | 1  | 1  |
| <i>Nautiloma pallida</i>       | 1 | 1  | 1  |
| <i>Rabbertia obtusifolia</i>   | 1 | 1  | 1  |
| <i>Delicatula micrantha</i>    | 1 | 1  | 1  |
| <i>Helichrysum scorpioides</i> | 1 | 1  | 1  |
| <i>Paspalum impressum</i>      | 1 | 1  | 1  |
| <i>Acetia melanoxylon</i>      | 1 | 1  | 1  |
| <i>Galium radula</i>           | 1 | 1  | 1  |
| <i>Lucalyptus biddestiana</i>  | 1 | 1  | 1  |
| <i>Lucalyptus radiata</i>      | 1 | 1  | 1  |
| <i>Leucopogon lanceolatus</i>  | 1 | 1  | 1  |
| <i>Pennisetum lineare</i>      | 1 | 1  | 1  |
| <i>Dielsia ulcifolia</i>       | 1 | 1  | 1  |
| <i>Acetia mucronata</i>        | 1 | 1  | 1  |
| <i>Exocarpos strictus</i>      | 1 | 1  | 1  |
| <i>Gonolobus leucostoides</i>  | 1 | 1  | 1  |
| <i>Tetraphena juncea</i>       | 1 | 1  | 1  |
| <i>Eleocharis aculeata</i>     | 1 | 1  | 1  |
| <i>Plumbago juncea</i>         | 1 | 1  | 1  |
| <i>Lucalyptus cypelliferus</i> | 1 | 1  | 1  |
| <i>Viola hederacea</i>         | 1 | 1  | 1  |
| <i>Hypochaeris radicata</i>    | 1 | 1  | 1  |
| <i>Hypochaeris radicata</i>    | 1 | 1  | 1  |

Coprosma quadrifida  
Veronica calycina  
Acacia dealbata  
Glycine clandestina  
Lethaea buergeri  
Dianella lasiocarpa  
Pultenaea juniperina  
Stellaria pumila  
Senecio quadrifidus  
Acrotylus prostratus  
Lacyniopsis diversus  
Indigofera australis  
Acrotylus senecioides  
Acrotylus humifusus  
Gonocarpus tetragynus  
Hemodorum violaceum  
Pentstemon pallidus  
Hibbertia obtusifolia  
Utricularia minor  
Helichrysum scorpioides  
Lupinus impressus  
Acacia melanoxylon  
Guthriea pallida  
Eucalyptus hydroleucom  
Eucalyptus pallata  
Lentopogon lanceolatus  
Persoonia linearis  
Davallia ulicifolia  
Acacia mucronata  
Eucalyptus strictus  
Gonocarpus tetragynus  
Lathyrus juncea  
Elaeagnus argentea  
Dianella caerulea  
Eucalyptus cyathophora  
Utricularia minor  
Mycobolus pallidus  
Hypericum glaberrimum

|                            |        |   |   |   |   |      |     |     |    |    |   |   |      |   |
|----------------------------|--------|---|---|---|---|------|-----|-----|----|----|---|---|------|---|
| Eucalyptus sieberi         | 123322 | 1 | 1 | 1 | 2 | 2211 | 1   | 111 | 21 | 2  | 2 | + | 1122 | + |
| Pteridium esculentum       | 2      | 1 | + | + | + | 121  | 111 | +   | +  | 11 | 1 | + | 12   | + |
| Lepidosperma laterale      | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Poa australis spp. agg.    | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Lomandra longifolia        | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Eucalyptus globoides       | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Cassinia longifolia        | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Dianella revoluta          | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Acacia falciformis         | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Macrobaena stipoides       | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Acacia meunieri            | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Ballandiera scandens       | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Eucalyptus polyanthemus    | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Eucalyptus sideroxylon     | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Notelaea venosa            | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Correa reflexa             | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Excoecarpus cupressiformis | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Banthonia longifolia       | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Eucalyptus smithii         | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Tieghemopanax multifidus   | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Platysace lanceolata       | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Acacia silvestris          | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Eriostemon trachyphyllus   | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Olearia iodochroa          | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Helicbrysum obcordatum     | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Persoonia confertiflora    | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Brachyloma daphnoides      | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Eucalyptus macrohyncha     | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Eucalyptus globulus        | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Eucalyptus mannifera       | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Leptospermum phyllioides   | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Lagenifera stipitata       | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Galium gaudichaudii        | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Stypandra glauca           | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Oxalis corniculata         | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Geranium potentilloides    | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Hydrocotyle hirta          | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Coneosperma volubile       | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Themeda australis          | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Coodenra ovata             | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Tetratheca pilosa          | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Hieracium rariiflorum      | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Platylodium formosum       | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Acacia pycnantha           | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |
| Wahlenbergia quadrifida    | +      | + | + | + | + | 111  | +   | +   | +  | +  | + | + | +    | + |







Table 5. Two-way table of Communities 15 and 16.

| COMMUNITY | 15            |   |   |   |   | 16      |   |   |   |   |
|-----------|---------------|---|---|---|---|---------|---|---|---|---|
|           | SUB-COMMUNITY |   |   |   |   | SPECIES |   |   |   |   |
| 1         | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 2         | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 3         | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 4         | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 5         | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 6         | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 7         | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 8         | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 9         | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 10        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 11        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 12        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 13        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 14        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 15        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 16        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 17        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 18        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 19        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 20        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 21        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 22        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 23        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 24        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 25        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 26        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 27        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 28        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 29        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 30        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 31        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 32        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 33        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 34        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 35        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 36        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 37        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 38        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 39        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 40        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 41        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 42        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 43        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 44        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 45        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 46        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 47        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 48        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 49        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 50        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 51        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 52        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 53        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 54        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 55        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 56        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 57        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 58        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 59        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 60        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 61        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 62        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 63        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 64        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 65        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 66        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 67        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 68        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 69        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 70        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 71        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 72        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 73        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 74        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 75        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 76        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 77        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 78        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 79        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 80        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 81        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 82        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 83        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 84        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 85        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 86        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 87        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 88        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 89        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 90        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 91        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 92        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 93        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 94        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 95        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 96        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 97        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 98        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 99        | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |
| 100       | 1             | 1 | 1 | 1 | 1 | 1       | 1 | 1 | 1 | 1 |



Table 6. Two-way table of Communities 17, 18, 19, 20, and 21

| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
|-------------|--|---|--|---|--|---|--|---|--|---|--|---|--|---|--|---|--|---|--|----|--|----|--|----|--|
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  | 6 |  | 7 |  | 8 |  | 9 |  | 10 |  | 11 |  | 12 |  |
| COMPOUNDITY |  | 1 |  | 2 |  | 3 |  | 4 |  | 5 |  |   |  |   |  |   |  |   |  |    |  |    |  |    |  |

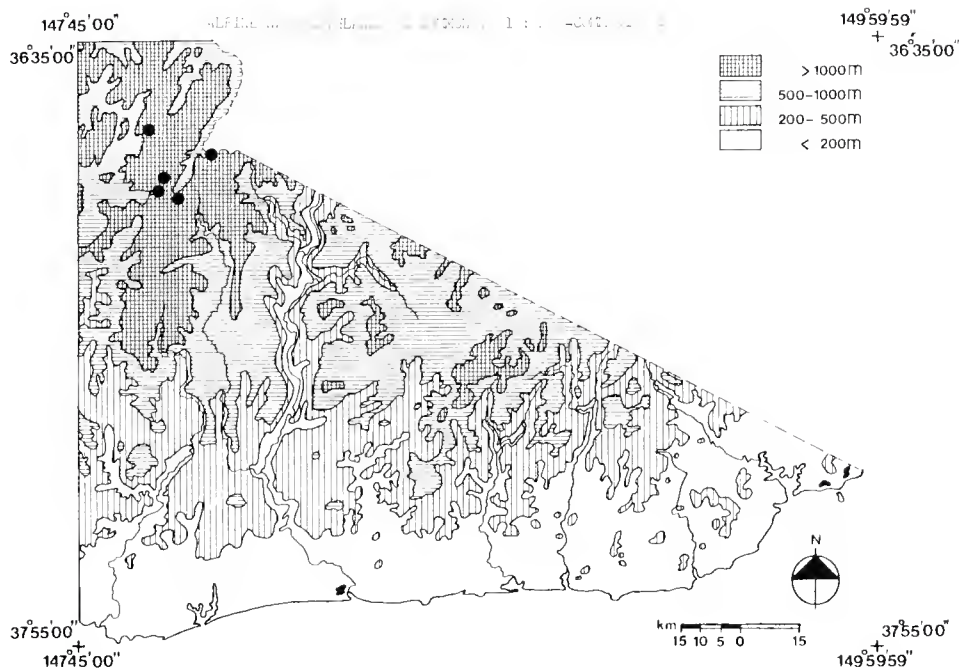
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Overall, we conclude  
 that the model in  
 Figure 10 can be used  
 confidently to predict  
 confidence in the  
 course of the  
 health care system  
 up to seven months  
 before the end of  
 the study period.  
 Science and  
 the media can  
 provide information  
 about the  
 future of the  
 health care system  
 in the United States.  
 The model can be  
 used to predict the  
 future of the health  
 care system in the  
 United States.





| CHARACTER SPECIES              | % FREQ. | +/A | CHARACTER SPECIES                | % FREQ. | +/A | CHARACTER SPECIES              | % FREQ. | +/A |
|--------------------------------|---------|-----|----------------------------------|---------|-----|--------------------------------|---------|-----|
| <i>Agropyron scaberrum</i>     | 100     | 1   | <i>Epacris breviflora</i>        | 80      | 1   | <i>Ranunculus lappaceus</i>    | 60      | +   |
| <i>Carex appressa</i>          | 100     | 1   | <i>Epacris microphylla</i>       | 80      | 1   | <i>baeckea utilis</i>          | 60      | 1   |
| <i>Carex gausichaudiana</i>    | 100     | 1   | <i>Epilobium gunnianum</i>       | 80      | +   | <i>Blechnum pennsylvanicum</i> | 60      | 1   |
| <i>Eucalyptus stellulata</i>   | 100     | 1   | <i>Gratiola peruviana</i>        | 80      | 1   | <i>Brachycome scapigera</i>    | 60      | +   |
| <i>Gnaphalium japonicum</i>    | 100     | 1   | <i>Hydrocotyle cithoripneles</i> | 80      | +   | <i>Callistemon sieberi</i>     | 60      | 1   |
| * <i>Helios lanatus</i>        | 100     | 1   | * <i>Juncus acutiflorus</i>      | 80      | +   | <i>Empodisma minus</i>         | 60      | 1   |
| <i>Hypericum japonicum</i>     | 100     | 1   | <i>Leptospermum myrtifolium</i>  | 80      | 1   | <i>Carex longibrachiata</i>    | 60      | 1   |
| * <i>Hypochaeris radiata</i>   | 100     | 1   | <i>Oreomyrrhis ciliata</i>       | 80      | 1   | <i>Craspedia glauca</i>        | 60      | +   |
| <i>Poa australis</i> spp. agg. | 100     | 1   | <i>Ranunculus pinnatifolius</i>  | 80      | 1   | <i>Dryoxia quadricata</i>      | 60      | +   |
| <i>Prunella vulgaris</i>       | 100     | 1   | <i>Pectio australis</i>          | 80      | 1   | <i>Uchelacine micrantha</i>    | 60      | +   |
| <i>Rubus parvifolius</i>       | 100     | 1   | <i>Rumex brownii</i>             | 80      | +   | <i>Epilobium cinereum</i>      | 60      | 1   |
| <i>Acaena anserinifolia</i>    | 80      | 1   | <i>Blechnum minus</i>            | 60      | +   | <i>Geranium atruncatum</i>     | 60      | +   |
| <i>Geranium potentilloides</i> | 60      | +   | <i>Eucalyptus camphora</i>       | 60      | 1   | <i>Gonolcarpus micrantha</i>   | 60      | +   |
| <i>Stellaria pungens</i>       | 80      | 1   | <i>Ranunculus rivularis</i>      | 60      | 1   | <i>Oreomyrrhis eriopoda</i>    | 60      | +   |
| * <i>Tritolium repens</i>      | 80      | 1   | <i>Asperula gunnii</i>           | 60      | +   | <i>Scleranthus biflorus</i>    | 60      | +   |
| <i>Asperula scoparia</i>       | 80      | 1   | * <i>Gerastium glomeratum</i>    | 60      | +   | <i>Themeda australis</i>       | 60      | 1   |
| * <i>Cirsium vulgare</i>       | 80      | +   | <i>Leucopogon suaveolens</i>     | 60      | 1   | <i>Juncus</i> spp.             | 60      | 1   |
| <i>Dichondra repens</i>        | 80      | 1   | <i>Myriophyllum propinquum</i>   | 60      | 1   |                                |         |     |

NOV. 1971: 5 (10.6% of total)

DISTRIBUTION: Upper Murray and upper Murrumbidgee river catchments.

ENVIRONMENT: Surrounds of meandering streams or subalpine plain, commonly with strong post development and associated poor drainage.

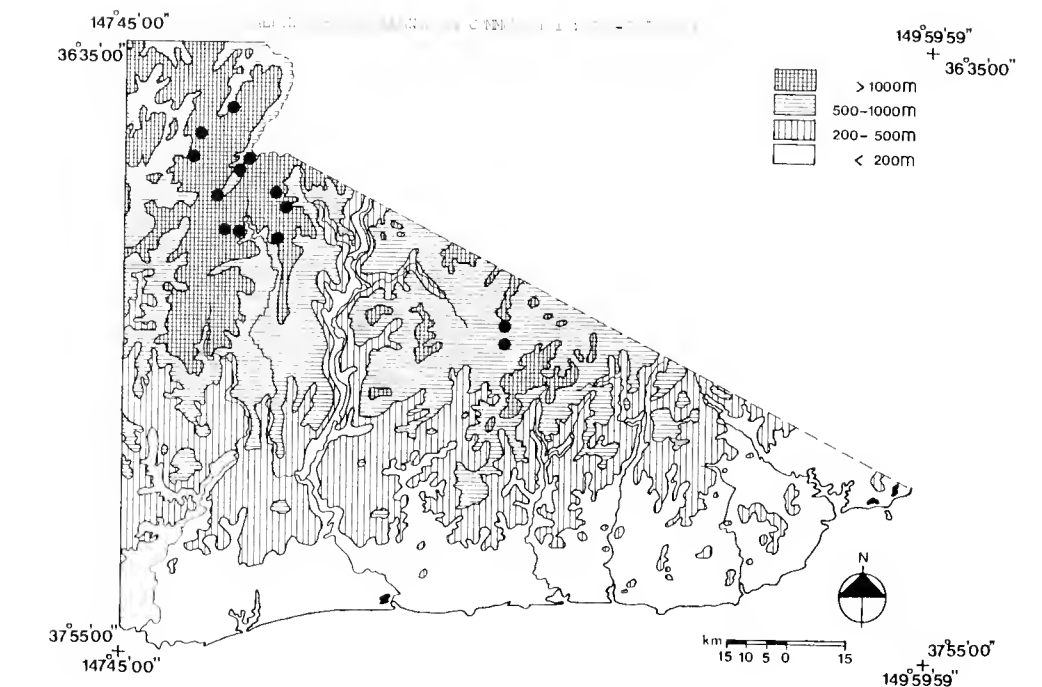
ALTITUDE: Mean = 1092 m, Highest = 1200 m, Lowest = 1000 m.

STRUCTURE: Low open-woodland to closed-herb.

MEAN FLORISTIC RICHNESS: 60 species per site

MEAN AREAL COMPOSITION: 13% of species, 11% of cover

NOTES: Occasional eucalypt, above a varied understory of grasses, sedges and forbs, give this sub-community an open park-like appearance. Scattered clumps or swathes of small-leaved sclerophyllous shrubs are also present. *Eucalyptus stellulata* and *E. camphora* are typical of poorly drained, sheltered subalpine plains; the latter being most common where perennial standing water is found. *Hydrocotyle cithoripneles*, *Myriophyllum propinquum* and *Ranunculus rivularis* grow in this free water. Disturbance of the site, by this sub-community through cattle grazing is reflected by the consistent occurrence of several weeds (e.g. *Helios lanatus*, *Tritolium repens* and *Cirsium vulgare*). The majority of herbs occurring in 60 or more quadrats are cosmopolitan, European species.



| CHARACTER SPECIES                      | % FREQ | C/A | CHARACTER SPECIES                | % FREQ | C/A | CHARACTER SPECIES                 | % FREQ | C/A |
|--|--------|-----|----------------------------------|--------|-----|-----------------------------------|--------|-----|
| <i>Asperula cynanchica</i>             | 93     | +   | <i>Gonocarpus micranthus</i>     | 79     | 1   | <i>Acaena anserinifolia</i>       | 57     | 1   |
| <i>Sparganium angustifolium</i>        | 93     | 1   | <i>Oreomyza ciliata</i>          | 79     | 1   | <i>Hydrocotyle sibthorpioides</i> | 57     | +   |
| <i>Deschampsia cespitosa</i> agg.      | 93     | 1   | <i>Stylidium graminifolium</i>   | 71     | 1   | <i>Scirpus merrillii</i>          | 57     | +   |
| <i>Deschampsia cespitosa</i>           | 93     | 1   | <i>Craspedia glauca</i>          | 71     | +   | <i>Baeckea guianensis</i>         | 57     | 2   |
| <i>Deschampsia cespitosa</i>           | 86     | 1   | <i>Leptospermum grandifolium</i> | 64     | 1   | <i>Conespermum retusum</i>        | 57     | 1   |
| <i>Deschampsia cespitosa</i>           | 86     | 1   | <i>Hakea microcarpa</i>          | 64     | 1   | <i>Eucalyptus pauciflora</i>      | 57     | 1   |
| <i>Deschampsia cespitosa</i> spp. agg. | 86     | +   | <i>Brachycome scapigera</i>      | 64     | 1   | <i>Eucalyptus stellulata</i>      | 57     | 1   |
| <i>Deschampsia cespitosa</i>           | 86     | 1   | <i>Callistemon sieberi</i>       | 64     | 1   | <i>Leptospermum myrtifolium</i>   | 57     | 1   |
| <i>Deschampsia breviflora</i>          | 86     | 1   | <i>Hypochaeris radicata</i>      | 64     | +   |                                   |        |     |

Wetland: 14 (1.4% of total)

Vegetation: Upper Murray, upper Buchan and Delegate River catchments about the Cobberas, Mt. Nunniong and northern Errinundra Plateau.

Environment: Open alpine and subalpine plains, commonly with strong peat development and associated poor drainage

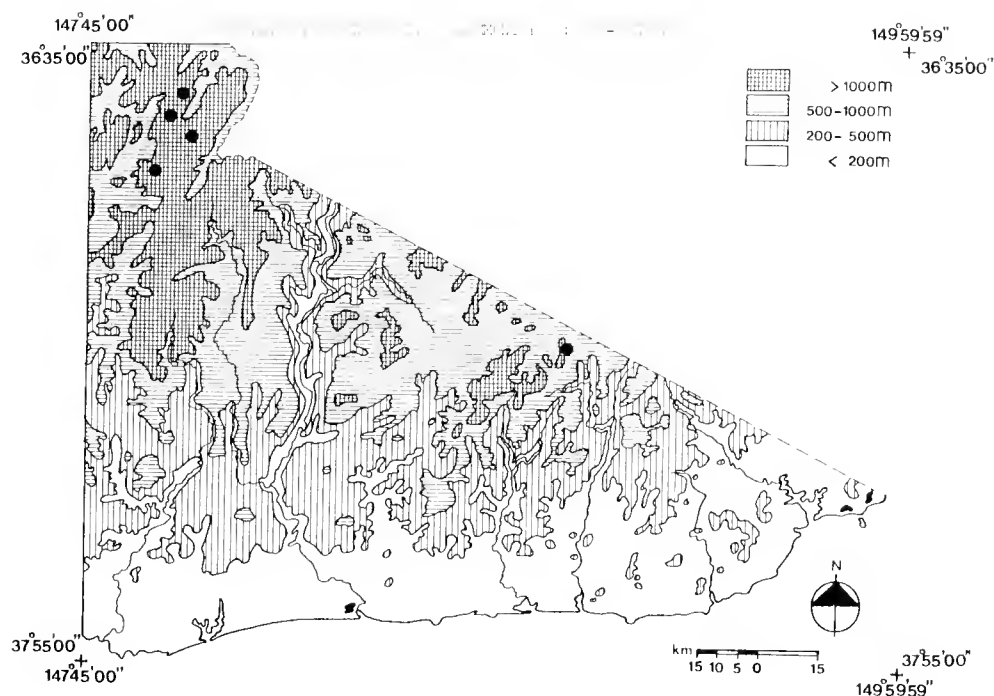
Altitude: Mean = 1259 m, Highest = 1520 m, Lowest = 870 m.

Vegetation: Low open-woodland to closed-heath

Mean floristic richness: 49 species per site

Mean herb cover: 3% of species, 2% of cover

Notes: Although classed as a closed wet heath occasional eucalypts may be present above the small-leaved sclerophyllous shrub layer. *Sphagnum* spp. generally form a carpeting ground layer. In contrast to sub-community 1.1, this sub-community has little evidence of disturbance.



| CHARACTER SPECIES                | % FREQ | C/A | CHARACTER SPECIES            | % FREQ | C/A | CHARACTER SPECIES             | % FREQ | C/A |
|----------------------------------|--------|-----|------------------------------|--------|-----|-------------------------------|--------|-----|
| <i>Acaena anserinifolia</i>      | 100    | 1   | <i>Leucopogon suaveolens</i> | 80     | 1   | <i>Gaultheria appressa</i>    | 60     | 1   |
| <i>Carex appressa</i>            | 100    | 2   | <i>Scirpus merrillii</i>     | 80     | 1   | <i>Juncus sarophorus</i>      | 60     | 1   |
| <i>Gnaphalium japonicum</i>      | 100    | +   | <i>Stellaria pungens</i>     | 80     | +   | <i>Olearia megalophylla</i>   | 60     | +   |
| <i>Lagenifera stipitata</i>      | 100    | 1   | <i>Cotula filicula</i>       | 80     | +   | <i>Olearia philopappa</i>     | 60     | +   |
| <i>Leptospermum grandifolium</i> | 100    | 2   | <i>Deyeuxia brachyathera</i> | 80     | 1   | <i>Pultenaea juniperina</i>   | 60     | 1   |
| <i>Poa australis</i> spp. agg.   | 100    | 1   | <i>Dianella tasmanica</i>    | 80     | 1   | <i>Acacia dealbata</i>        | 60     | 1   |
| <i>Blechnum pennamarina</i>      | 80     | 1   | <i>Mentha laxiflora</i>      | 60     | +   | <i>Blechnum minus</i>         | 60     | 1   |
| <i>Tasmannia lanceolata</i>      | 80     | 1   | <i>Asperula scoparia</i>     | 60     | +   | <i>Blechnum nudum</i>         | 60     | 1   |
| <i>Geranium potentilloides</i>   | 80     | +   | <i>Epilobium gunnianum</i>   | 60     | +   | <i>Polystichum proliferum</i> | 60     | 1   |

NO. OF SITES: 5 (0.8% of total)

DISTRIBUTION: Mt. Misery area (upper Murray River) and Errinundra Plateau.

ENVIRONMENT: Streamsides of subalpine and montane valleys

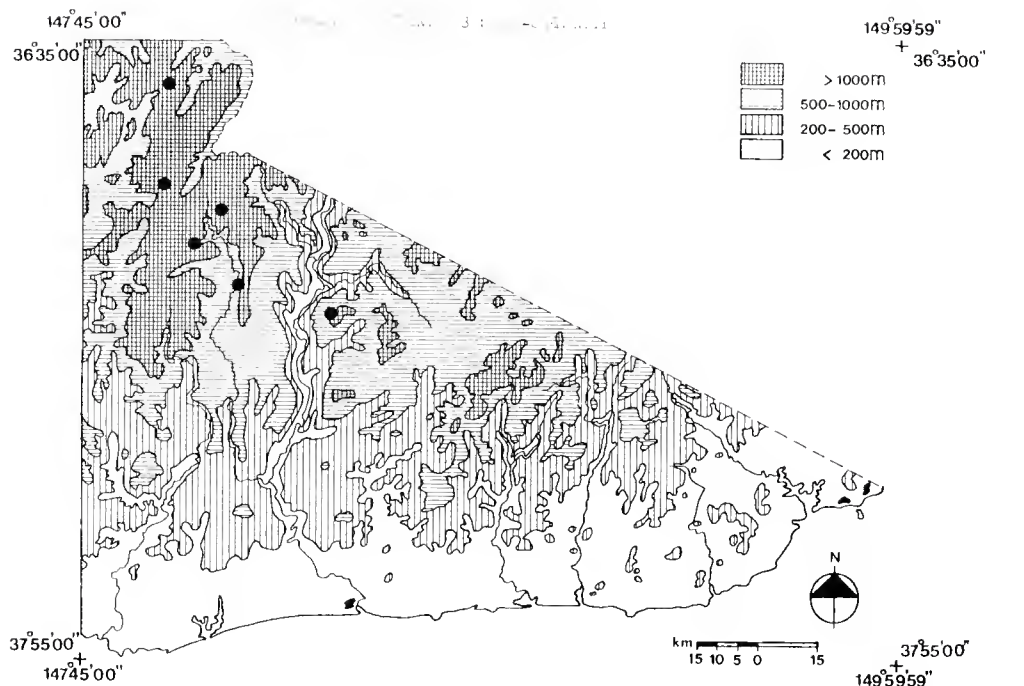
ALTITUDE: Mean = 1270 m, Highest = 1520 m, Lowest = 870 m.

STRUCTURE: Woodland to Tall open-forest

MEAN FLORESTIC RICHNESS: 43 species per site

MEAN WEED COMPOSITION: 4% of species, 3% of cover

NOTES: Although no eucalypts are character species of sub-community 2.1, *Eucalyptus delegatensis*, *E. rubida* or *E. pauciflora* are sometimes present. *Leptospermum grandifolium* often forms a closed-scrub on stream margins, but doesn't extend to drier sites. The understory consists of a mixture of small-leaved sclerophyllous species (e.g. *Leucopogon suaveolens*, *Pultenaea juniperina*) and broad-leaved species (e.g. *Gaultheria appressa*, *Tasmannia lanceolata*). The herb layer includes a range of ferns (*Blechnum* spp., *Polystichum proliferum*) and sedges (*Carex appressa*, *Scirpus merrillii*).



| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES                  | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|--------------------------------|--------|-----|------------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Acacia dealbata</i>         | 100    | 1   | <i>Stellaria pungens</i>           | 83     | 1   | <i>Epilobium cinereum</i>      | 67     | +   |
| <i>Coprosma hirtella</i>       | 100    | 1   | <i>Viola betonicifolia</i>         | 83     | 1   | <i>Hydrocotyle hirta</i>       | 67     | 1   |
| <i>Eucalyptus delegatensis</i> | 100    | 2   | <i>Polystichum proliferum</i>      | 67     | 1   | <i>Lagenifera stipitata</i>    | 67     | 1   |
| <i>Viola hereracea</i>         | 100    | 1   | <i>Arthropodium milleflorum</i>    | 67     | 1   | <i>Microseris scapigera</i>    | 67     | +   |
| <i>Acaena anserinifolia</i>    | 83     | 1   | <i>Eucalyptus pauciflora</i>       | 67     | 1   | * <i>Picris hieracioides</i>   | 67     | 1   |
| <i>Asperula scoparia</i>       | 83     | 1   | <i>Conocarpus tetragynus</i>       | 67     | 1   | <i>Poa australis</i> spp. agg. | 67     | 2   |
| <i>Clematis aristata</i>       | 83     | +   | <i>Helichrysum acuminatum</i>      | 67     | 1   | <i>Pultenaea juniperina</i>    | 67     | 2   |
| <i>Craspedia glauca</i>        | 83     | 1   | <i>Luzula campestris</i> spp. agg. | 67     | +   | <i>Ranunculus plebeius</i>     | 67     | 1   |
| <i>Geranium potentilloides</i> | 83     | +   | <i>Cotula filicula</i>             | 67     | 1   | <i>Veronica derwentia</i>      | 67     | 1   |
| <i>Helichrysum scorpioides</i> | 83     | 1   | <i>Danthonia pilosa</i>            | 67     | 1   | <i>Wahlenbergia gloriosa</i>   | 67     | 1   |

NO. OF SITES: 6 (1.0% of total)

DISTRIBUTION: Mt. Misery, Mt. Nunniong and Mt. Gelantipy districts.

ENVIRONMENT: Montane and subalpine moist sheltered valleys and south facing slopes

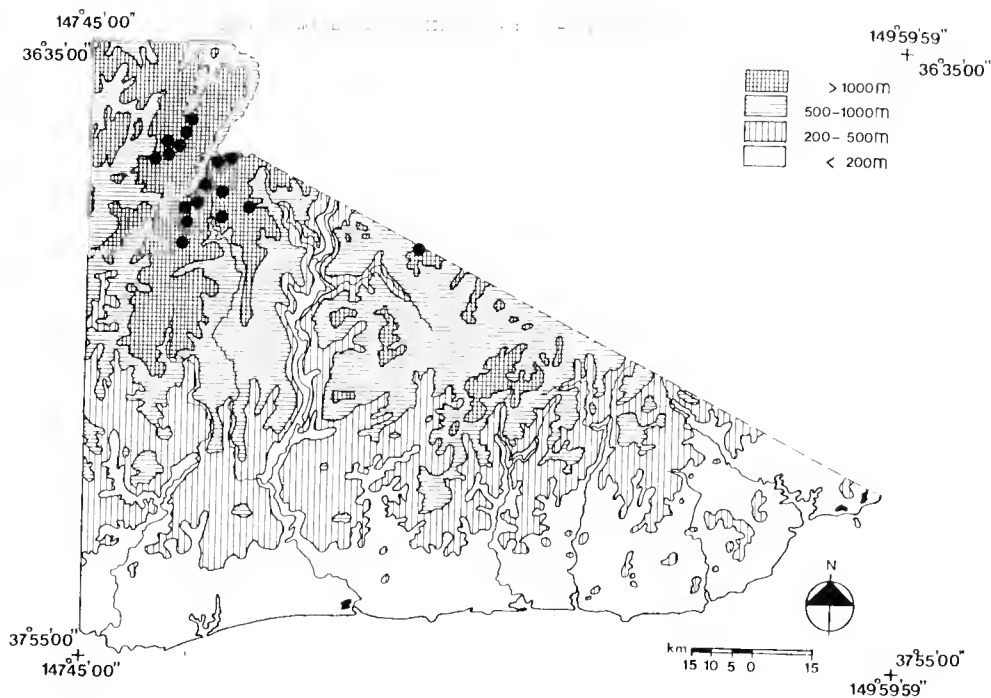
ALTITUDE: Mean = 1328 m, Highest = 1460 m, Lowest = 1200 m.

STRUCTURE: Tall open-forest

MEAN FLORISTIC RICHNESS: 41 species per site

MEAN WEED COMPOSITION: 3% of species, 2% of cover

NOTES: Montane forest generally has a sparse shrub layer, however fire or windfalls may encourage dense growth in limited areas. The herb layer usually approaches complete cover. The introduced species, *Picris hieracioides* is frequent in alpine and subalpine communities, and is often considered naturalized within them. *Eucalyptus delegatensis* is an important timber species, and in this sub-community virgin stands are presently being exploited. The open park-like understory and tall trees within this sub-community make it an attractive and imposing vegetation.



| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES           | % FREQ | C/A | CHARACTER SPECIES                  | % FREQ | C/A |
|--------------------------------|--------|-----|-----------------------------|--------|-----|------------------------------------|--------|-----|
| <i>Eucalyptus pauciflora</i>   | 100    | 2   | <i>Asperula scoparia</i>    | 63     | 1   | <i>Carex breviculmis</i>           | 61     | 1   |
| <i>Helichrysum scorpioides</i> | 100    | 1   | <i>Viola betonicifolia</i>  | 72     | +   | <i>Luzula campestris</i> spp. agg. | 61     | +   |
| <i>Poa australis</i> spp. agg. | 100    | 2   | <i>Epilobium cinereum</i>   | 67     | 1   | <i>Olearia erubescens</i>          | 61     | 1   |
| <i>Stellaria pungens</i>       | 94     | 1   | <i>Acroba asperinifolia</i> | 67     | 1   | <i>Anthropodium milleflorum</i>    | 61     | +   |
| <i>Craspedia glauca</i>        | 89     | 1   | <i>Danthonia pilosa</i>     | 67     | 1   | * <i>Hypochaeris radiata</i>       | 56     | +   |
| <i>Leucopogon suaveolens</i>   | 89     | 1   | <i>Pultenaea juniperina</i> | 67     | 1   | <i>Senecio latus</i>               | 56     | +   |
| <i>Brachycome aculeata</i>     | 89     | 1   | <i>Daviesia ulicifolia</i>  | 61     | 1   | <i>Stylidium graminifolium</i>     | 6      | 1   |

NO. OF SITES: 1d (3.0% of total)

DISTRIBUTION: Mt. Misery, Mt. Murrumbidgee and Cobberas districts with an isolated occurrence near Ft. Lingaring.

ENVIRONMENT: Subalpine ridges and adjacent slopes often with granite outcrops, well-drained soil.

ALTITUDE: Mean = 1467 m, Highest = 1620 m, Lowest = 1320 m.

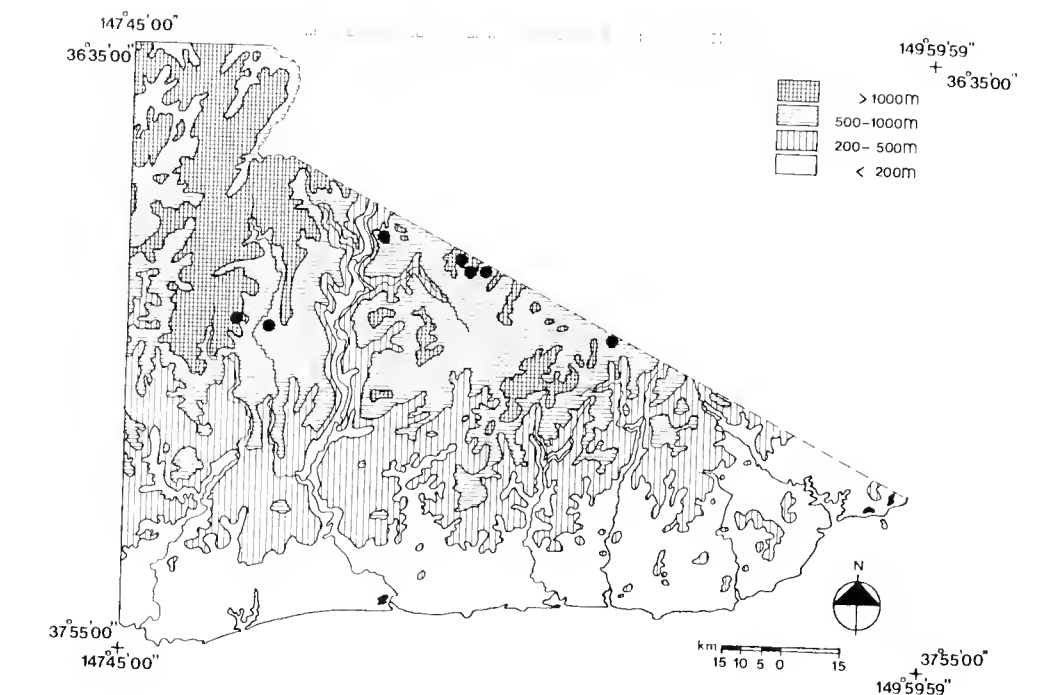
STRUCTURE: Woodland

MEAN FLORISTIC RICHNESS: 37 species per site

MEAN WEED COMPOSITION: 3% of species, 2% of cover

NOTES: This snow gum (or white sallee) woodland is the predominant vegetation of the subalpine region. The sparse, low shrub layer is often dominated by a member of the Papilionaceae (e.g. *Daviesia ulicifolia*, *Pultenaea juniperina*) but *Leucopogon suaveolens* is more consistently present. The dominant ground cover species is *Poa australis* spp. agg. (tussock grass), which has been able to survive and capitalize on repeated burning and grazing. In many districts seasonal burning has been undertaken by cattlemen to increase "green pick" for cattle.





| CHARACTER SPECIES               | % FRQ | C/A | CHARACTER SPECIES                  | % FRQ | C/A | CHARACTER SPECIES              | % FRQ | C/A |
|---------------------------------|-------|-----|------------------------------------|-------|-----|--------------------------------|-------|-----|
| <i>Eucalyptus divers</i>        | 100   | 1   | <i>Woo. tyle harta</i>             | 75    | 1   | <i>Pultenaea juniperina</i>    | 63    | 1   |
| <i>Con. arjus tetragyna</i>     | 66    | 1   | <i>Viola heteracea</i>             | 75    | 1   | <i>Geranium potentilloidea</i> | 63    | 1   |
| <i>Con. australis</i> spp. agg. | 66    | 2   | <i>Cassinia longifolia</i>         | 63    | 1   | <i>Stellaria pungens</i>       | 63    | +   |
| <i>Pteridium esculentum</i>     | 66    | 1   | <i>Acacia dealbata</i>             | 63    | 1   | <i>Eucalyptus obliqua</i>      | 63    | 1   |
| <i>Acacia longifolia</i>        | 75    | 1   | <i>Luzula campestris</i> spp. agg. | 63    | +   | <i>Hypochaeris radicata</i>    | 63    | +   |
| <i>Eucalyptus rubra</i>         | 75    | 1   |                                    |       |     |                                |       |     |

1. P. 111111: 2 (1.1% of total)

1. 1111111111: St. Dunsmuir, Mt. Cunningham and Mt. Canterbury districts.

1. 1111111111: Colletal soils on slopes, particularly of northern aspect

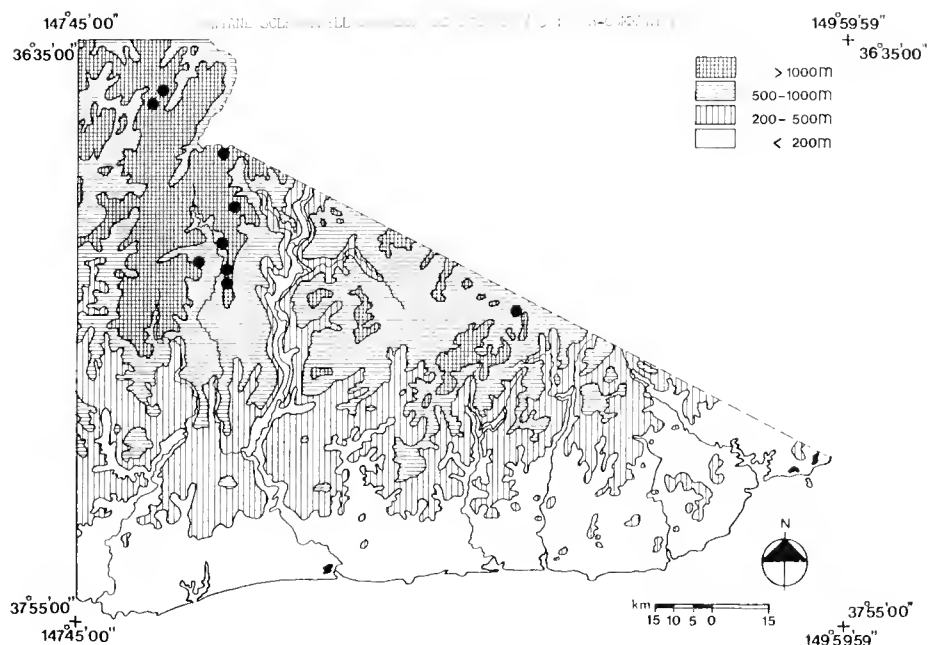
1. 1111111111: 1200 - 990 m, Highest = 1150 m, Lowest = 540 m.

1. 1111111111: Woodland to Open-forest

1. 1111111111: 34 species per site

1. 1111111111: 3% of species, 2% of cover

1. 1111111111: The understorey consists of opportunistic shrubs and herbs common throughout the high country. Sub-community 11 is the highest altitude sub-community in which *Pteridium exultantum* is a character species.



| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES            | % FREQ | C/A | CHARACTER SPECIES             | % FREQ | C/A |
|--------------------------------|--------|-----|------------------------------|--------|-----|-------------------------------|--------|-----|
| <i>Daviesia ulicifolia</i>     | 100    | 1   | <i>Pultenaea juniperina</i>  | 80     | 2   | <i>Tetratheca bauerifolia</i> | 70     | 1   |
| <i>Monotoca scoparia</i>       | 100    | 1   | <i>Dichelachne micrantha</i> | 80     | 1   | <i>Brachycome aculeata</i>    | 60     | +   |
| <i>Poa australis</i> spp. agg. | 100    | 1   | <i>Eucalyptus dives</i>      | 70     | 1   | <i>Dianella tasmanica</i>     | 60     | 1   |
| <i>Stylidium graminifolium</i> | 100    | 1   | <i>Gonocarpus tetragynus</i> | 70     | +   | <i>Epacris impressa</i>       | 60     | 1   |
| <i>Eucalyptus pauciflora</i>   | 90     | 1   | <i>Acacia dealbata</i>       | 70     | 1   | <i>Holthysium scorpioides</i> | 60     | +   |
| <i>Lomandra longifolia</i>     | 90     | 1   | <i>Eucalyptus rubica</i>     | 70     | 1   | <i>Olearia erubescens</i>     | 60     | 1   |

NO. OF SITES: 10 (1.7% of total)

DISTRIBUTION: Wombargo, Cobberas and Mt. Misery Districts with an isolated occurrence near Jambunan.

ENVIRONMENT: Impervious soils, on slopes especially of northern aspect

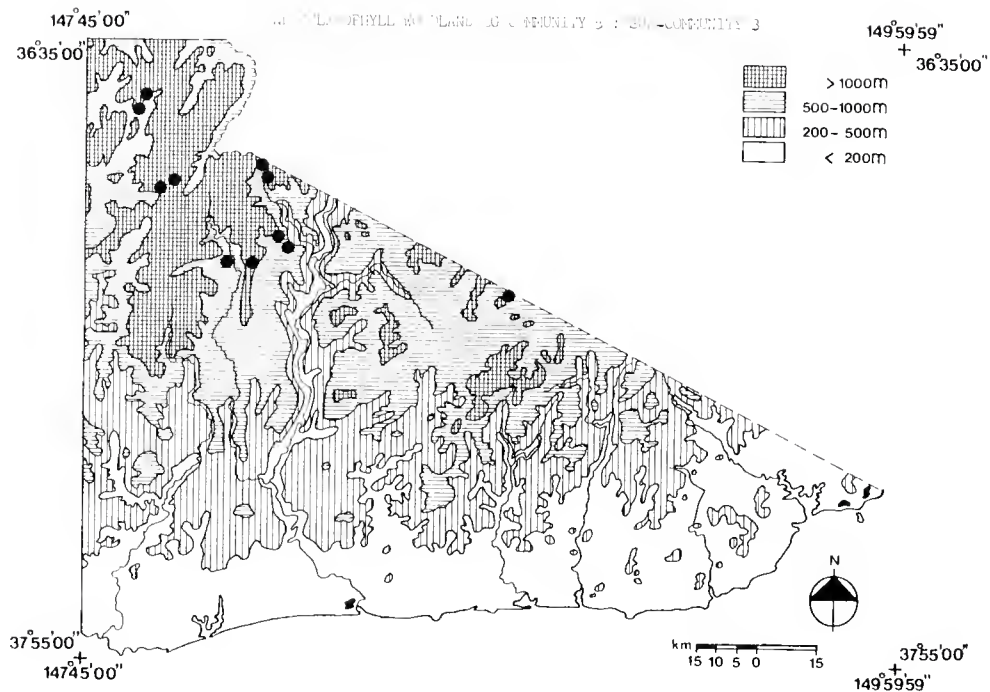
ALTITUDE: Mean = 1157 m, Highest = 1360 m, Lowest = 840 m.

STRUCTURE: Woodland

MEAN FLORISTIC RICHNESS: 32 species per site

MEAN WEED COMPOSITION: 3% of species, 2% of cover

NOTES: The majority of character species in this sub-community are widespread, although a few of the woody species are typically found in the highlands (e.g. *Eucalyptus pauciflora*, *Olearia erubescens*, *Tetratheca bauerifolia*). This sub-community has many similarities with community 9 from which it has been differentiated by altitude. The dominant species in the shrub layer are members of the Papilionaceae (e.g. *Daviesia ulicifolia* and *Pultenaea juniperina*). The high cover values for one or both of these opportunistic species may reflect a high frequency of fire. This sub-community has the lowest number of character species within community 5, which reinforces fire as a significant factor.



| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES             | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|--------------------------------|--------|-----|-------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Eucalyptus rubida</i>       | 100    | 1   | <i>Hibbertia obtusifolia</i>  | 82     | 1   | <i>Danthonia pilosa</i>        | 64     | 1   |
| <i>Gonocarpus tetragynus</i>   | 100    | 1   | <i>Themeda australis</i>      | 82     | 1   | <i>Exocarpos strictus</i>      | 64     | 1   |
| <i>Poa australis</i> spp. agg. | 100    | 1   | <i>Hypericum gramineum</i>    | 73     | 1   | <i>Danthonia racemosa</i>      | 55     | +   |
| <i>Acrotriche serrulata</i>    | 91     | 1   | <i>Pultenaea juniperina</i>   | 73     | 2   | <i>Dichelachne micrantha</i>   | 55     | 1   |
| <i>Eucalyptus pauciflora</i>   | 82     | 1   | <i>Eucalyptus dives</i>       | 73     | 1   | <i>Acacia dealbata</i>         | 55     | 1   |
| <i>Lomandra longifolia</i>     | 82     | 1   | <i>Platylobium formosum</i>   | 73     | 1   | <i>Dianella revoluta</i>       | 55     | +   |
| <i>Orachyloma daphnioides</i>  | 82     | 1   | * <i>Hypochaeris radicata</i> | 64     | +   | <i>Stylidium graminifolium</i> | 55     | 1   |
| * <i>Centaurium pulchellum</i> | 82     | +   | <i>Acaena anserinifolia</i>   | 64     | +   |                                |        |     |

NO. of SITES: 11 (1.9% of total)

DISTRIBUTION: Cobberas, Mt. Wombargo and Mt. Misery districts with an isolated occurrence near Mt. Delegate.

ENVIRONMENT: Impervious skeletal soils, usually north facing slopes

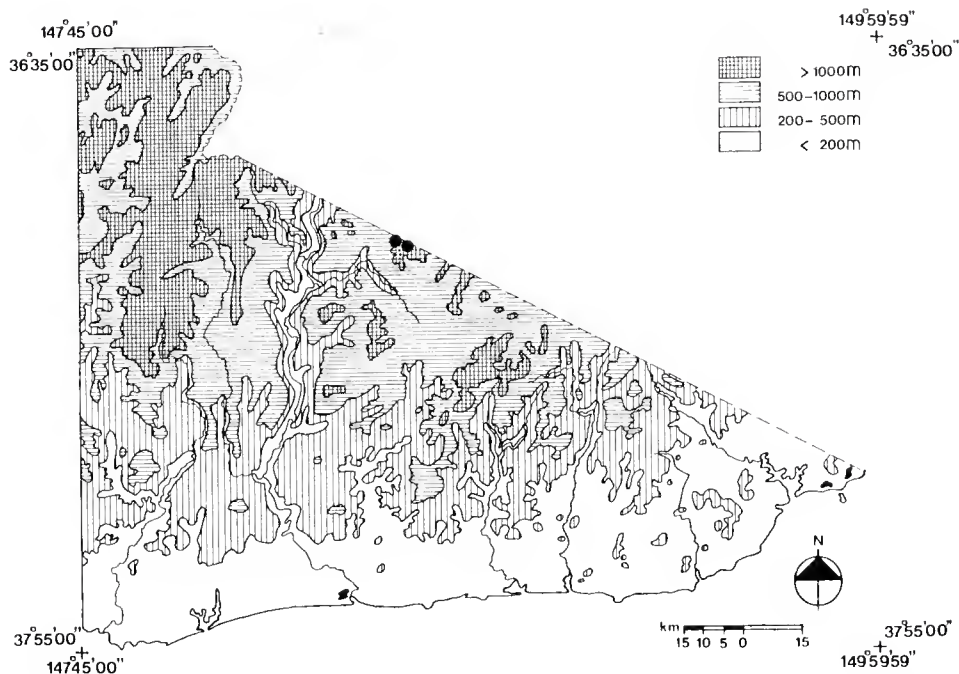
ALTITUDE: Mean = 989 m, Highest = 1160 m, Lowest = 900 m.

STRUCTURE: Woodland

MEAN FLORISTIC RICHNESS: 38 species per site

REAL WEED COMPOSITION: 7% of species, 4% of cover

NOTES: Although *Eucalyptus pauciflora* and *E. rubida* are typical highland species the understory is comprised of foothill and lowland species. This sub-community has the lowest mean altitude of this community and affinities with community 9 are apparent. Opportunistic members of the Papilionaceae (*Pultenaea juniperina* and *Daviesia ulicifolia*) are prominent in the understory. The complement of these two species cover values is generally high, implying disturbance by fire. The presence of two introduced species, *Centaurium pulchellum* and *Hypochaeris radicata* is a further indication of disturbance. Community 5 is the only sub-community with *Themeda australis* as a character species.



| CHARACTER SPECIES             | % FREQ | C/A | CHARACTER SPECIES                  | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|-------------------------------|--------|-----|------------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Acacia obliquinervis</i>   | 100    | 1   | <i>Eucalyptus pauciflora</i>       | 100    | 1   | <i>Poa australis</i> spp. agg. | 100    | 1   |
| <i>Daviesia mimosoides</i>    | 100    | 1   | <i>Grevillea victoriae</i>         | 100    | 2   | <i>Stellaria pungens</i>       | 100    | 1   |
| <i>Dianella tasmanica</i>     | 100    | 1   | <i>Luzula campestris</i> spp. agg. | 100    | +   | <i>Veronica perfoliata</i>     | 100    | 1   |
| <i>Eucalyptus glaucescens</i> | 100    | 1   | <i>Phelipium ozothamnoides</i>     | 100    | 2   |                                |        |     |

NO. OF SITES: 2 (0.3% of total)

DISTRIBUTION: Mt. Tingaringy.

ENVIRONMENT: Rocky north-facing slopes with skeletal soils

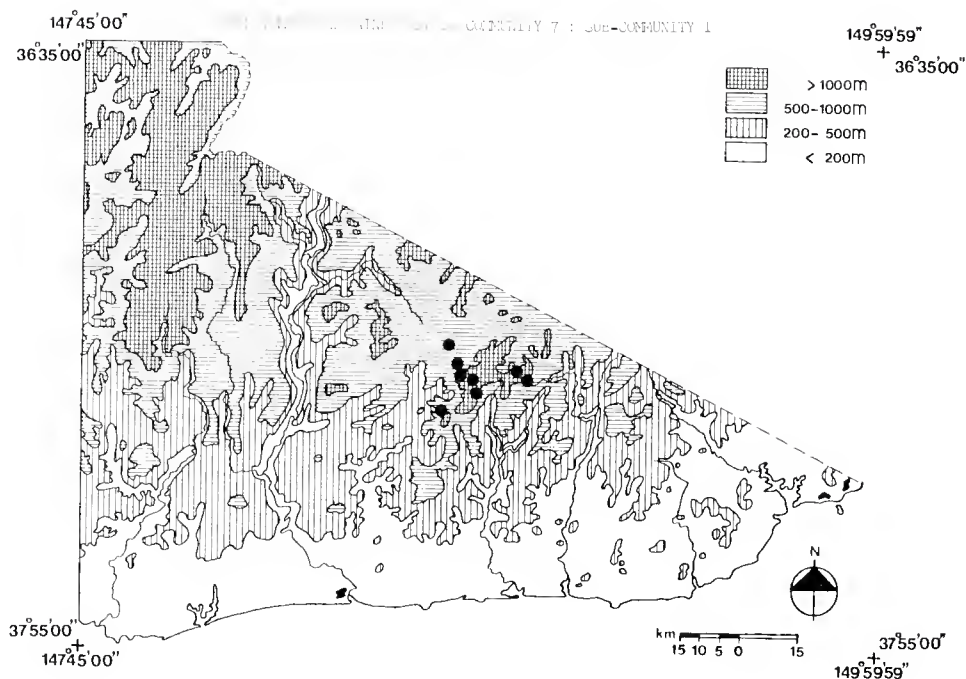
ALTITUDE: Mean = 1429 m, Highest = 1448 m, Lowest = 1410 m.

STRUCTURE: Tall shrubland to Closed-scrub

MEAN FLORISTIC RICHNESS: 25 species per site

MEAN WEED COMPOSITION: 3% of species, 1% of cover

NOTES: The eucalypts in this "community" generally have a mallee habit, forming a tall shrubland above a closed-scrub of *Grevillea victoriae* and *Phelipium ozothamnoides*. Many of the character species are only characteristic of this community within the study area (e.g. *Daviesia mimosoides*, *P. ozothamnoides*, *Eucalyptus glaucescens*), and a number of significant species are peculiar to this area. *E. glaucescens* (Tingaringy gum) has gained it's common name from the mountain on which this community is found.



| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES           | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|--------------------------------|--------|-----|-----------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Atherosperma moschatum</i>  | 100    | 2   | <i>Uncinia tenella</i>      | 88     | 1   | <i>Asplenium bulbiferum</i>    | 75     | 1   |
| <i>Blechnum fluviatile</i>     | 100    | +   | <i>Dicksonia antarctica</i> | 88     | 4   | <i>Clematis aristata</i>       | 75     | 1   |
| <i>Blechnum wattsi</i>         | 100    | 1   | <i>Histiopteris incisa</i>  | 88     | +   | <i>Fieldia australis</i>       | 75     | 1   |
| <i>Elaeocarpus holopetalus</i> | 100    | 2   | <i>Pittosporum bicolor</i>  | 88     | 1   | <i>Viola hederacea</i>         | 75     | +   |
| <i>Grammitis billardieri</i>   | 100    | 1   | <i>Polyphlebium venosum</i> | 88     | 1   | <i>Prostanthera lasianthos</i> | 63     | +   |
| <i>Polopoa ericoides</i>       | 100    | 1   | <i>Acacia dealbata</i>      | 75     | 1   | <i>Acacia frutescens</i>       | 63     | 2   |
| <i>Eucalyptus nitens</i>       | 88     | 1   | <i>Tasmannia lanceolata</i> | 75     | 1   | <i>Australina muelleri</i>     | 63     | 1   |
| <i>Polyotichum proliferum</i>  | 88     | 1   |                             |        |     |                                |        |     |

PERCENTAGE: 8 (1.4% of total)

LOCATION: Vicinity of Mt. Flinders, the Goonmirk Range and the Coast Range.

ENVIRONMENT: Sheltered gullies and slopes within a high altitude, high rainfall (approx. 1300 mm per annum) region

ELEVATION: Mean = 998 m, Highest = 1300 m, Lowest = 760 m.

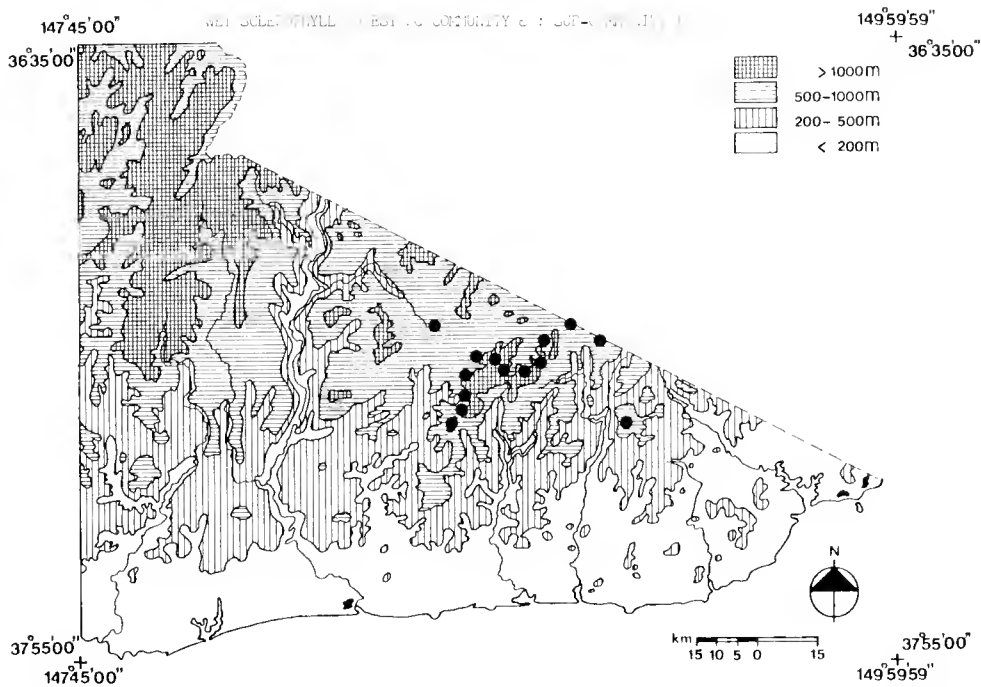
VEGETATION: Closed-forest

FLORISTIC RICHNESS: 31 species per site

FLORAL COMPOSITION: 0% of species, 0% of cover

NOTE: Cool-temperate closed-forests of the mainland occur only in this region, Strezlecki Ranges, the Central Highlands and the Otway Ranges. The latter three regions support forests dominated by *Nothofagus cunninghamii*, a species absent from east Gippsland. *Atherosperma moschatum*, a tree occurring frequently with *N. cunninghamii*, is the dominant species of sub-community 7.1 and very large trees of *Elaeocarpus holopetalus* form the subsidiary canopy element. Ferns particularly *Dicksonia antarctica* and *Blechnum* spp. dominate the lower strata and several species (*Polyphlebium venosum*, *Asplenium bulbiferum* and *Grammitis billardieri*) are common epiphytes. Extensive bushfires have not occurred within this region since European settlement and until recently access has been very limited. As a result this sub-community comprises some very old examples of this restricted kind of vegetation.





| CHARACTER SPECIES      | % FREQ | C/A | CHARACTER SPECIES       | % FREQ | C/A | CHARACTER SPECIES       | % FREQ | C/A |
|------------------------|--------|-----|-------------------------|--------|-----|-------------------------|--------|-----|
| Dicksonia antarctica   | 94     | 2   | Acacia dealbata         | 76     | 1   | Pittosporum bicolor     | 59     | 1   |
| Histiopteris incisa    | 94     | 1   | Poa australis spp. agg. | 76     | 1   | Olearia phlogopappa     | 53     | 1   |
| Polystichum proliferum | 94     | 2   | Eucalyptus nitens       | 65     | 1   | Elaeocarpus holopetalus | 53     | 1   |
| Telopea creades        | 88     | 1   | Notelaea ligustrina     | 65     | +   | Olearia argophylla      | 53     | 1   |
| Stellaria flaccida     | 82     | 1   | Clematis aristata       | 65     | +   | Olearia lirata          | 53     | 1   |
| Blechnum watsii        | 82     | 1   | Dianella tasmanica      | 65     | 1   | Pteridium esculentum    | 53     | +   |
| Tasmania lanceolata    | 76     | 1   |                         |        |     |                         |        |     |

NO. OF SITES: 17 (2.9% of total)

DISTRIBUTION: Scattered between Bonang and near Buldah, but most abundant on the Errinundra Plateau and the Coast Range.

ENVIRONMENT: Sheltered sites, either south facing slopes or gullies within high-rainfall highlands

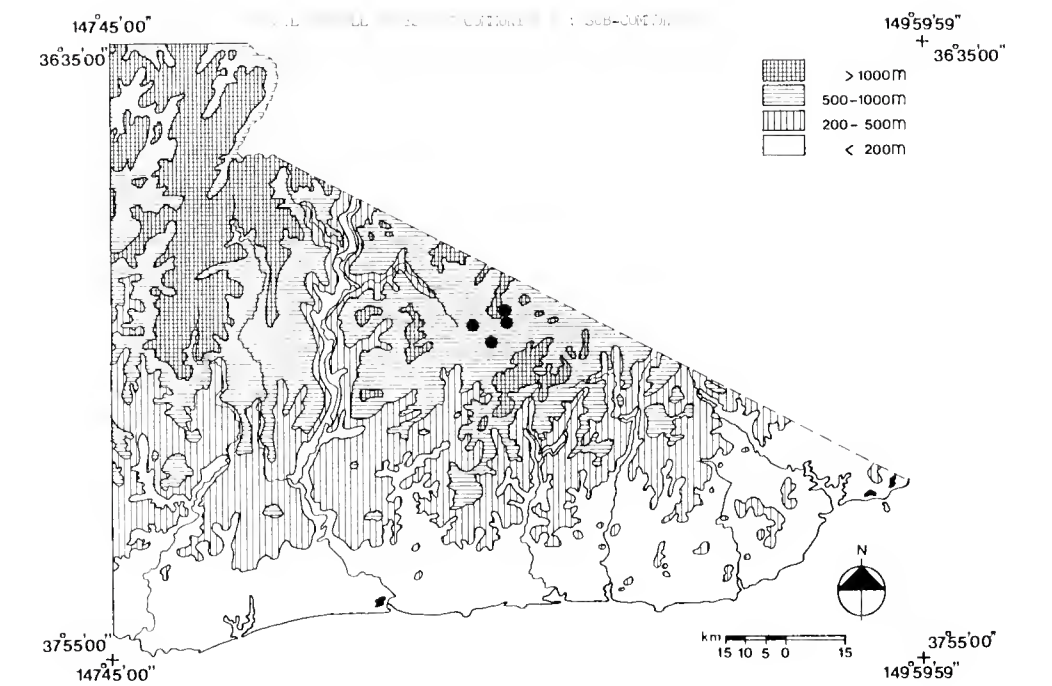
ALTITUDE: Mean = 1022 m, Highest = 1160 m, Lowest = 720 m.

STRUCTURE: Tall open-forest

MEAN FLORISTIC RICHNESS: 28 species per site

MEAN WEED COMPOSITION: 1% of species, 1% of cover

NOTES: This sub-community is transitional between the cool-temperate closed-forest of 7.1 and the tall open-forest of 8.2. *Leucopogon maccraei* and *Persoonia silvatica* are more abundant in this ecotonal forest than any other of the study area. The largest trees of *Eucalyptus nitens* and *F. fastigata* in Victoria occur in this sub-community and are currently being utilised for sawlog production.



| CHARACTER SPECIES            | % FREQ | C/A | CHARACTER SPECIES             | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|------------------------------|--------|-----|-------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Sedfordia arborescens</i> | 87     | 1   | <i>Clematis aristata</i>      | 70     | 1   | <i>Eucalyptus cypellocarpa</i> | 57     | 1   |
| <i>Eucalyptus obliqua</i>    | 83     | 1   | <i>Polystichum proliferum</i> | 67     | 1   | <i>Dicksonia antarctica</i>    | 53     | 1   |
| <i>Aisophila australis</i>   | 83     | 1   | <i>Manella tasmanica</i>      | 67     | 1   | <i>Blechnum wattsii</i>        | 53     | 2   |
| <i>Pteridium esculentum</i>  | 77     | 1   | <i>Smilax australis</i>       | 67     | 1   | <i>Tylophora barbata</i>       | 53     | 1   |
| <i>Coprosma quadrifida</i>   | 77     | 1   | <i>Tetarrhena juncea</i>      | 67     | 1   | <i>Geranium potentilloides</i> | 50     | 1   |
| <i>Pomaderris aspera</i>     | 77     | 1   | <i>Stellaria flaccida</i>     | 63     | 1   | <i>Poa australis</i> spp. agg. | 50     | 1   |
| <i>Olearia argophylla</i>    | 77     | 1   | <i>Olearia lirata</i>         | 60     | 1   | <i>Acacia dealbata</i>         | 47     | 1   |
| <i>Viola hederacea</i>       | 70     | +   |                               |        |     |                                |        |     |

NO. OF SITES: 16 (4.4% of total)

DISTRIBUTION: Widespread throughout montane areas between Mt. Coopracambra, Mt. Delegate and the Riddiung Plateau.

ENVIRONMENT: Cool, wet slopes, generally of southerly aspect. Also gullies bounded by drier forest types

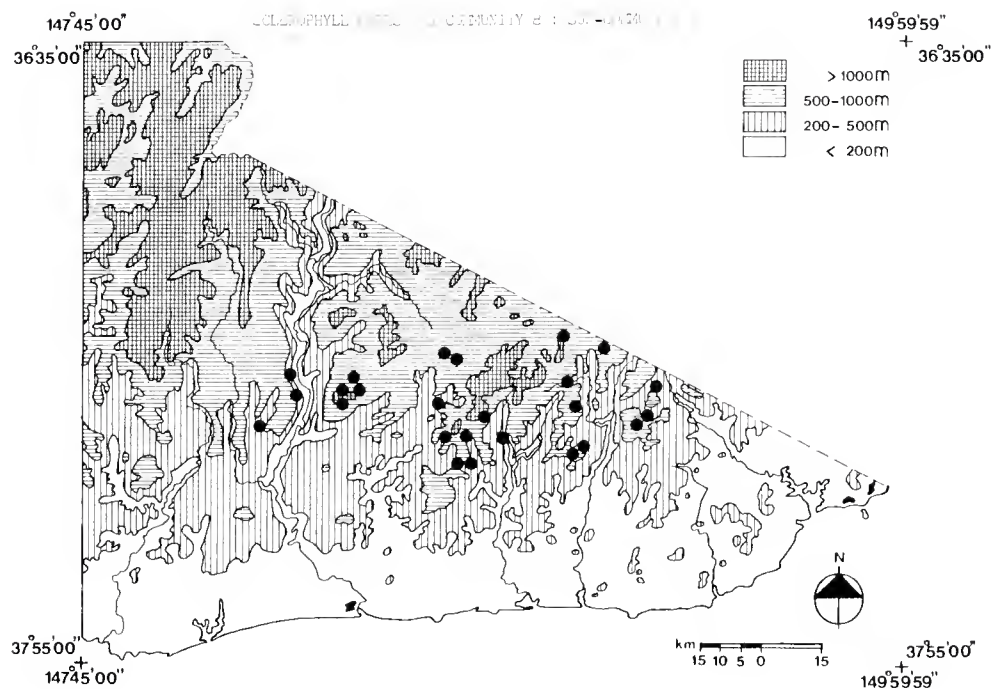
ALTITUDE: Mean = 717 m, Highest = 1000 m, Lowest = 540 m.

STRUCTURE: Tall open-forest

MEAN FLOREST HEIGHT: 36 species per site

MEAN WEED COMPOSITION: 0% of species, 0% of cover

NOTE: This sub-community is floristically and structurally comparable to montane tall open-forests elsewhere in Victoria. However, East Gippsland endemics such as *Eucalyptus fastigata*, *Smilax australis* and *Tylophora barbata* are lacking from the latter. *Dicksonia antarctica* ubiquitous throughout the more sheltered sub-communities 7.1 and 8.1, is less common in 6.2 than is *Aisophila australis* (another tree fern). Other ferns, particularly *Blechnum* spp. are absent and epiphytic species are rare in this sub-community.



| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES                  | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|--------------------------------|--------|-----|------------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Clematis aristata</i>       | 100    | +   | <i>Helichrysum bracteatum</i>      | 80     | +   | <i>Acaena anserinifolia</i>    | 60     | +   |
| <i>Cotula filicula</i>         | 100    | +   | <i>Leucopogon suaveolens</i>       | 80     | 1   | <i>Bedfordia arborescens</i>   | 60     | 2   |
| <i>Dianella tasmanica</i>      | 100    | 1   | <i>Luzula campestris</i> spp. agg. | 80     | +   | <i>Cassinia aculeata</i>       | 60     | +   |
| <i>Eucalyptus radiata</i>      | 100    | 1   | <i>Olearia argophylla</i>          | 80     | +   | <i>Coprosma quadrifida</i>     | 60     | 1   |
| <i>Hydrocotyle hirta</i>       | 100    | +   | <i>Olearia phlogopappa</i>         | 80     | 1   | <i>Alsophila australis</i>     | 60     | +   |
| <i>Stellaria flaccida</i>      | 100    | +   | <i>Pteridium esculentum</i>        | 80     | 1   | <i>Dicksonia antarctica</i>    | 60     | 1   |
| <i>Viola hegeracea</i>         | 100    | 1   | <i>Acacia mucronata</i>            | 60     | 1   | <i>Eucalyptus cypellocarpa</i> | 60     | 1   |
| <i>Lagenifera stipitata</i>    | 80     | 1   | <i>Daviesia ulicifolia</i>         | 60     | 1   | * <i>Hypochoeris radicata</i>  | 60     | +   |
| <i>Poa australis</i> spp. agg. | 80     | 1   | <i>Helichrysum scorpioides</i>     | 60     | +   | <i>Olearia lirata</i>          | 60     | 1   |
| <i>Acacia melanoxylon</i>      | 80     | 1   | <i>Lomandra longifolia</i>         | 60     | 1   | <i>Polystichum proliferum</i>  | 60     | 1   |
| <i>Eucalyptus obliqua</i>      | 80     | 1   | <i>Foranthera microphylla</i>      | 60     | +   | <i>Senecio linearifolius</i>   | 60     | 1   |
| <i>Geranium potentilloides</i> | 80     | 1   | <i>Pultenaea juniperina</i>        | 60     | +   | <i>Veronica calycina</i>       | 60     | +   |
| <i>Gonocarpus tetragynus</i>   | 80     | 1   |                                    |        |     |                                |        |     |

NO. OF SITES: 4 (0.7% of total)

DISTRIBUTION: Localised to the north of the Errinundra Plateau between Bonang and Bendock.

ENVIRONMENT: Broad open gullies usually containing minor watercourses

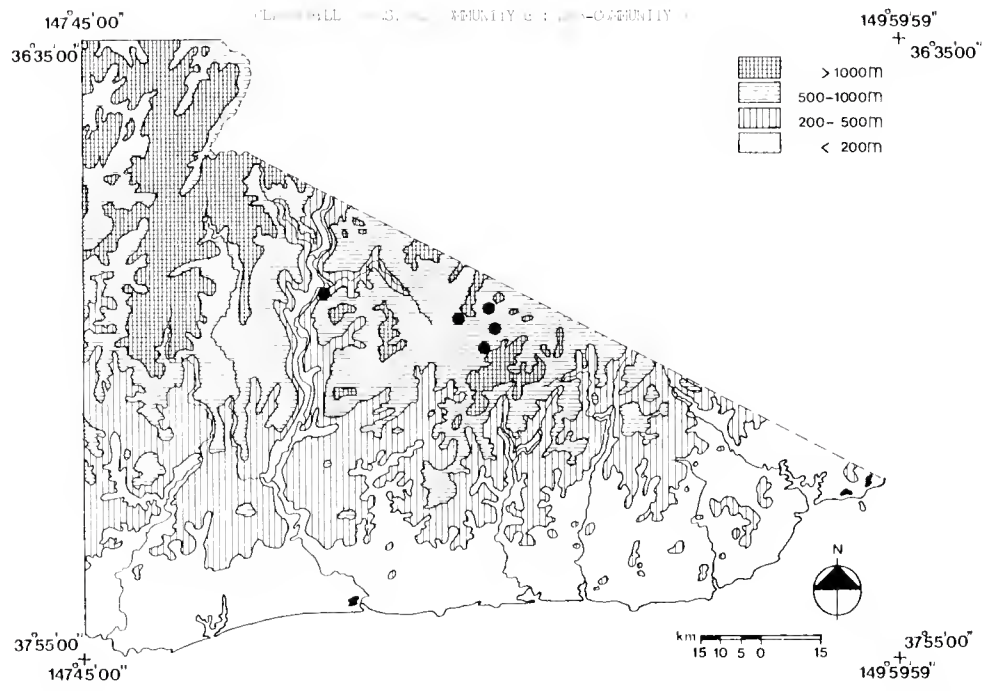
ALTITUDE: Mean = 955 m, Highest = 1000 m, Lowest = 930 m.

STRUCTURE: Tall open-forest

MEAN FLORISTIC RICHNESS: 50 species per site

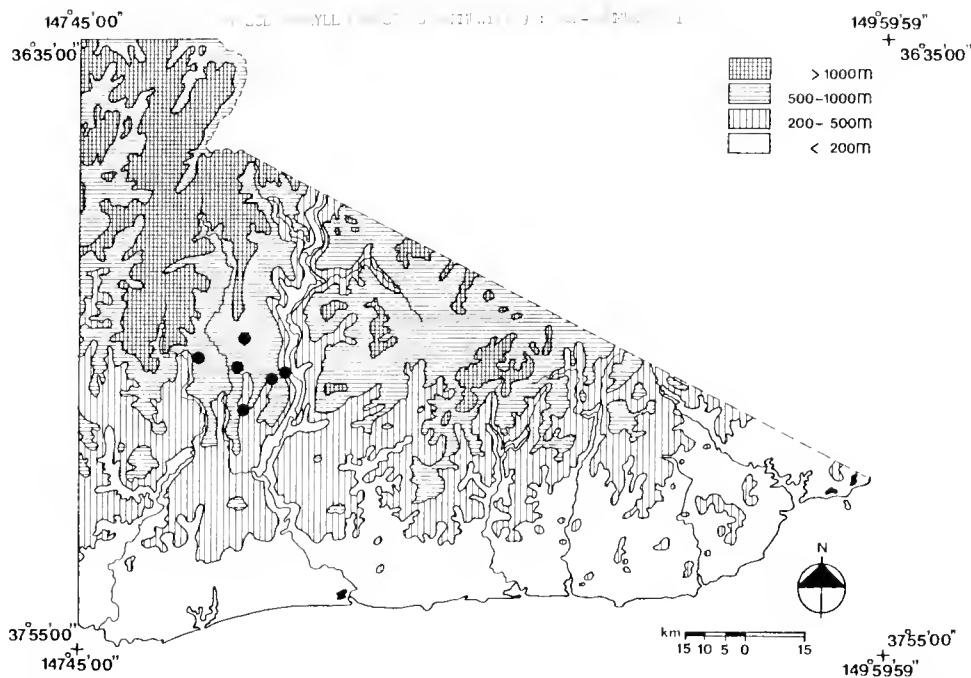
MEAN WEED COMPOSITION: 3% of species, 2% of cover

NOTES: This sub-community shares floristic affinities with lower-altitude forests. The absence of many species characteristic of the wetter sub-communities 7.1, 8.1, 8.2 and the presence of such species as *Pultenaea juniperina*, *Acacia mucronata* and *Daviesia ulicifolia* indicate 8.3 is a drier forest. An abundance of the latter species is indicative of vegetation which has been previously burnt. Several other character species of this sub-community are indicative of disturbance.



| DATA FOR SPECIES             | FREQ | C/A | CHARACTER SPECIES                  | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|------------------------------|------|-----|------------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Eucalyptus radiata</i>    | 100  | 1   | <i>Eucalyptus radiata</i>          | 80     | 1   | <i>Dicksonia antarctica</i>    | 80     | 1   |
| <i>Acacia laetevirens</i>    | 100  | 1   | <i>Leucopogon suaveolens</i>       | 80     | 1   | <i>Passantria lancolata</i>    | 80     | 3   |
| <i>Eucalyptus viminalis</i>  | 100  | 1   | <i>Luzula campestris</i> spp. agg. | 80     | +   | <i>Cryzophila cyanocarpa</i>   | 80     | +   |
| <i>Coronidium petiolatum</i> | 100  | +   | <i>Stellaria flaccida</i>          | 80     | 1   | <i>Gahnia sieberiana</i>       | 80     | 1   |
| <i>Coronidium</i> spp. etc.  | 100  | 1   | <i>C. procera quadrifida</i>       | 80     | 1   | <i>Helichrysum scorpioides</i> | 80     | +   |
| <i>Coronidium stipitatum</i> | 80   | +   | <i>Lomocarpus tetragynus</i>       | 80     | +   | <i>Lomocarpus longifolia</i>   | 80     | +   |
| <i>Platanus umbonifolia</i>  | 80   | 1   | <i>Helichrysum bracteatum</i>      | 80     | +   | <i>Dicksonia silvestris</i>    | 80     | 1   |
| <i>Coronidium</i> spp.       | 80   | 1   | <i>Stellaria pargens</i>           | 80     | +   | <i>Polytrichum proliferum</i>  | 80     | 1   |
| <i>Coronidium</i> spp.       | 80   | +   | <i>Pleurothidium nudum</i>         | 80     | 1   | <i>Pteridium esculentum</i>    | 80     | 1   |
| <i>Coronidium</i> spp.       | 80   | +   | <i>Carex appressa</i>              | 80     | 1   | <i>Viola hederacea</i>         | 80     | +   |
| <i>Coronidium</i> spp.       | 80   | +   |                                    |        |     |                                |        |     |

1. Distribution: (a) (b) (c) (d) (e) (f) (g) (h) (i) (j) (k) (l) (m) (n) (o) (p) (q) (r) (s) (t) (u) (v) (w) (x) (y) (z) (aa) (ab) (ac) (ad) (ae) (af) (ag) (ah) (ai) (aj) (ak) (al) (am) (an) (ao) (ap) (aq) (ar) (as) (at) (au) (av) (aw) (ax) (ay) (az) (ba) (bb) (bc) (bd) (be) (bf) (bg) (bh) (bi) (bj) (bk) (bl) (bm) (bn) (bo) (bp) (bq) (br) (bs) (bt) (bu) (bv) (bw) (bx) (by) (bz) (ca) (cb) (cc) (cd) (ce) (cf) (cg) (ch) (ci) (cj) (ck) (cl) (cm) (cn) (co) (cp) (cq) (cr) (cs) (ct) (cu) (cv) (cw) (cx) (cy) (cz) (da) (db) (dc) (dd) (de) (df) (dg) (dh) (di) (dj) (dk) (dl) (dm) (dn) (do) (dp) (dq) (dr) (ds) (dt) (du) (dv) (dw) (dx) (dy) (dz) (ea) (eb) (ec) (ed) (ee) (ef) (eg) (eh) (ei) (ej) (ek) (el) (em) (en) (eo) (ep) (eq) (er) (es) (et) (eu) (ev) (ew) (ex) (ey) (ez) (fa) (fb) (fc) (fd) (fe) (ff) (fg) (fh) (fi) (fj) (fk) (fl) (fm) (fn) (fo) (fp) (fq) (fr) (fs) (ft) (fu) (fv) (fw) (fx) (fy) (fz) (ga) (gb) (gc) (gd) (ge) (gf) (gg) (gh) (gi) (gj) (gk) (gl) (gm) (gn) (go) (gp) (gq) (gr) (gs) (gt) (gu) (gv) (gw) (gx) (gy) (gz) (ha) (hb) (hc) (hd) (he) (hf) (hg) (hh) (hi) (hj) (hk) (hl) (hm) (hn) (ho) (hp) (hq) (hr) (hs) (ht) (hu) (hv) (hw) (hx) (hy) (hz) (ia) (ib) (ic) (id) (ie) (if) (ig) (ih) (ii) (ij) (ik) (il) (im) (in) (io) (ip) (iq) (ir) (is) (it) (iu) (iv) (iw) (ix) (iy) (iz) (ja) (jb) (jc) (jd) (je) (jf) (jg) (jh) (ji) (jj) (jk) (jl) (jm) (jn) (jo) (jp) (jq) (jr) (js) (jt) (ju) (jv) (jw) (jx) (jy) (jz) (ka) (kb) (kc) (kd) (ke) (kf) (kg) (kh) (ki) (kj) (kk) (kl) (km) (kn) (ko) (kp) (kq) (kr) (ks) (kt) (ku) (kv) (kw) (kx) (ky) (kz) (la) (lb) (lc) (ld) (le) (lf) (lg) (lh) (li) (lj) (lk) (ll) (lm) (ln) (lo) (lp) (lq) (lr) (ls) (lt) (lu) (lv) (lw) (lx) (ly) (lz) (ma) (mb) (mc) (md) (me) (mf) (mg) (mh) (mi) (mj) (mk) (ml) (mm) (mn) (mo) (mp) (mq) (mr) (ms) (mt) (mu) (mv) (mw) (mx) (my) (mz) (na) (nb) (nc) (nd) (ne) (nf) (ng) (nh) (ni) (nj) (nk) (nl) (nm) (nn) (no) (np) (nq) (nr) (ns) (nt) (nu) (nv) (nw) (nx) (ny) (nz) (oa) (ob) (oc) (od) (oe) (of) (og) (oh) (oi) (oj) (ok) (ol) (om) (on) (oo) (op) (oq) (or) (os) (ot) (ou) (ov) (ow) (ox) (oy) (oz) (pa) (pb) (pc) (pd) (pe) (pf) (pg) (ph) (pi) (pj) (pk) (pl) (pm) (pn) (po) (pp) (pq) (pr) (ps) (pt) (pu) (pv) (pw) (px) (py) (pz) (qa) (qb) (qc) (qd) (qe) (qf) (qg) (qh) (qi) (qj) (qk) (ql) (qm) (qn) (qo) (qp) (qq) (qr) (qs) (qt) (qu) (qv) (qw) (qx) (qy) (qz) (ra) (rb) (rc) (rd) (re) (rf) (rg) (rh) (ri) (rj) (rk) (rl) (rm) (rn) (ro) (rp) (rq) (rr) (rs) (rt) (ru) (rv) (rw) (rx) (ry) (rz) (sa) (sb) (sc) (sd) (se) (sf) (sg) (sh) (si) (sj) (sk) (sl) (sm) (sn) (so) (sp) (sq) (sr) (ss) (st) (su) (sv) (sw) (sx) (sy) (sz) (ta) (tb) (tc) (td) (te) (tf) (tg) (th) (ti) (tj) (tk) (tl) (tm) (tn) (to) (tp) (tq) (tr) (ts) (tt) (tu) (tv) (tw) (tx) (ty) (tz) (ua) (ub) (uc) (ud) (ue) (uf) (ug) (uh) (ui) (uj) (uk) (ul) (um) (un) (uo) (up) (uq) (ur) (us) (ut) (uu) (uv) (uw) (ux) (uy) (uz) (va) (vb) (vc) (vd) (ve) (vf) (vg) (vh) (vi) (vj) (vk) (vl) (vm) (vn) (vo) (vp) (vq) (vr) (vs) (vt) (vu) (vv) (vw) (vx) (vy) (vz) (wa) (wb) (wc) (wd) (we) (wf) (wg) (wh) (wi) (wj) (wk) (wl) (wm) (wn) (wo) (wp) (wq) (wr) (ws) (wt) (wu) (wv) (ww) (wx) (wy) (wz) (xa) (xb) (xc) (xd) (xe) (xf) (xg) (xh) (xi) (xj) (xk) (xl) (xm) (xn) (xo) (xp) (xq) (xr) (xs) (xt) (xu) (xv) (xw) (xx) (xy) (xz) (ya) (yb) (yc) (yd) (ye) (yf) (yg) (yh) (yi) (yj) (yk) (yl) (ym) (yn) (yo) (yp) (yq) (yr) (ys) (yt) (yu) (yv) (yw) (yx) (yy) (yz) (za) (zb) (zc) (zd) (ze) (zf) (zg) (zh) (zi) (zj) (zk) (zl) (zm) (zn) (zo) (zp) (zq) (zr) (zs) (zt) (zu) (zv) (zw) (zx) (zy) (zz)



| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES             | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|--------------------------------|--------|-----|-------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Eucalyptus sieberi</i>      | 100    | +   | <i>Dianella caerulea</i>      | 83     | +   | <i>Pteridium esculentum</i>    | 67     | 1   |
| <i>Veronica calycina</i>       | 100    | +   | <i>Loxandra longifolia</i>    | 83     | 1   | <i>Cassinia longifolia</i>     | 67     | 1   |
| <i>Dianella tasmanica</i>      | 83     | 1   | <i>Viola hederacea</i>        | 83     | 1   | <i>Hypericum gramineum</i>     | 67     | +   |
| <i>Eucalyptus globoidea</i>    | 83     | 1   | <i>Clematis glycinoides</i>   | 67     | +   | <i>Lepidosperma laterale</i>   | 67     | 1   |
| <i>Poa australis</i> spp. agg. | 83     | 1   | <i>Gonocarpus tetracoides</i> | 67     | 1   | <i>Oxalis corniculata</i>      | 67     | +   |
| <i>Pultenaea juniperina</i>    | 83     | 2   | <i>Coprosma quadrifida</i>    | 67     | 1   | <i>Wahlenbergia quadrifida</i> | 67     | +   |
| <i>Acacia dealbata</i>         | 83     | 1   |                               |        |     |                                |        |     |

NO. OF SITES: 4 (1.4% of total)

DISTRIBUTION: Upper Snowy and Tumbarra River catchments.

ENVIRONMENT: Ridges on foothills, often rocky, soils siliceous sands or clay

ALTITUDE: Mean = 633 m, Highest = 800 m, Lowest = 540 m.

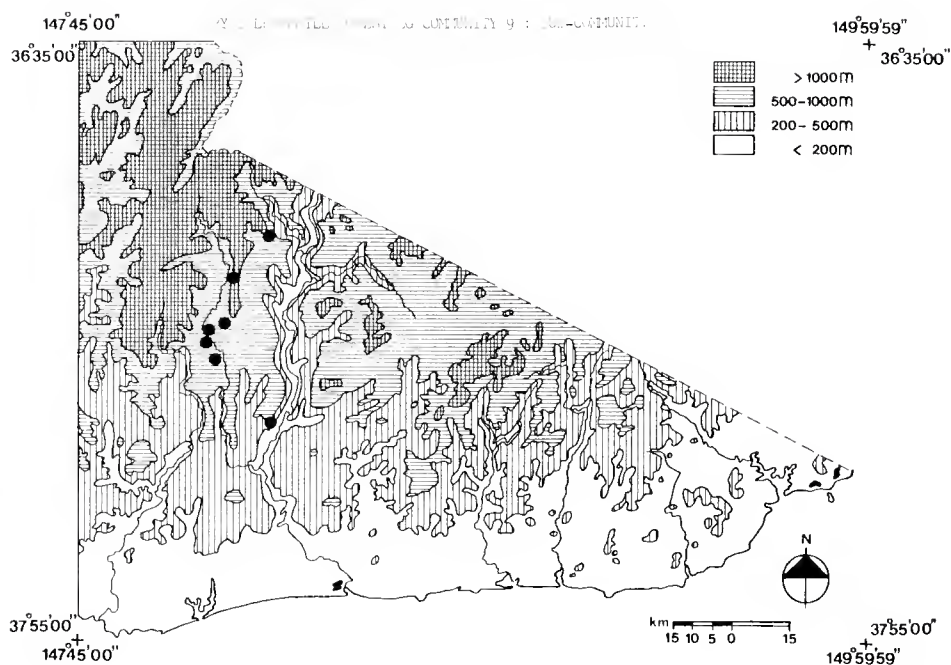
STRUCTURE: Open-forest to woodland

MEAN FLORISTIC RICHNESS: 33 species per site

MEAN WEED COMPOSITION: 2% of species, 1% of cover

NOTES: *Eucalyptus sieberi* and *E. globoidea* grow with a quite different suite of species in the foothills compared to the lowlands. The shrub layer is mostly made up of opportunistic species such as *Pultenaea juniperina*, *Cassinia longifolia* and *Acacia dealbata*, whilst the ground layer consists of a sparse cover of herbs. Although *Dianella tasmanica* is usually associated with wet environments, it grows in this dry environment as a rupestral plant, and in this situation effective rainfall may be relatively high.





| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES             | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|--------------------------------|--------|-----|-------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Cassinia longifolia</i>     | 100    | 1   | <i>Dichelachne micrantha</i>  | 88     | +   | <i>Astroloma humifusum</i>     | 75     | 1   |
| <i>Gonocarpus tetragynus</i>   | 100    | 1   | <i>Hibbertia obtusifolia</i>  | 88     | 1   | <i>Helichrysum scorpioides</i> | 63     | 1   |
| <i>Lomandra longifolia</i>     | 100    | 1   | <i>Dianella tasmanica</i>     | 75     | +   | <i>Danthonia pallida</i>       | 63     | 1   |
| <i>Poa australis</i> spp. agg. | 100    | 1   | <i>Epacris impressa</i>       | 75     | 1   | <i>Hardenbergia violacea</i>   | 63     | +   |
| <i>Acrotriche serrulata</i>    | 88     | 1   | <i>Acacia dealbata</i>        | 75     | 1   | <i>Hypericum gramineum</i>     | 63     | 1   |
| <i>Pultenaea juniperina</i>    | 88     | 2   | <i>Tetratheca bauerifolia</i> | 75     | 1   | <i>Indigofera australis</i>    | 63     | 1   |

NO. OF SITES: 8 (1.4% of total)

DISTRIBUTION: Upper Snowy and Timbarra River catchments.

ENVIRONMENT: Ridges and slopes of northerly aspect, on well drained heavy soils

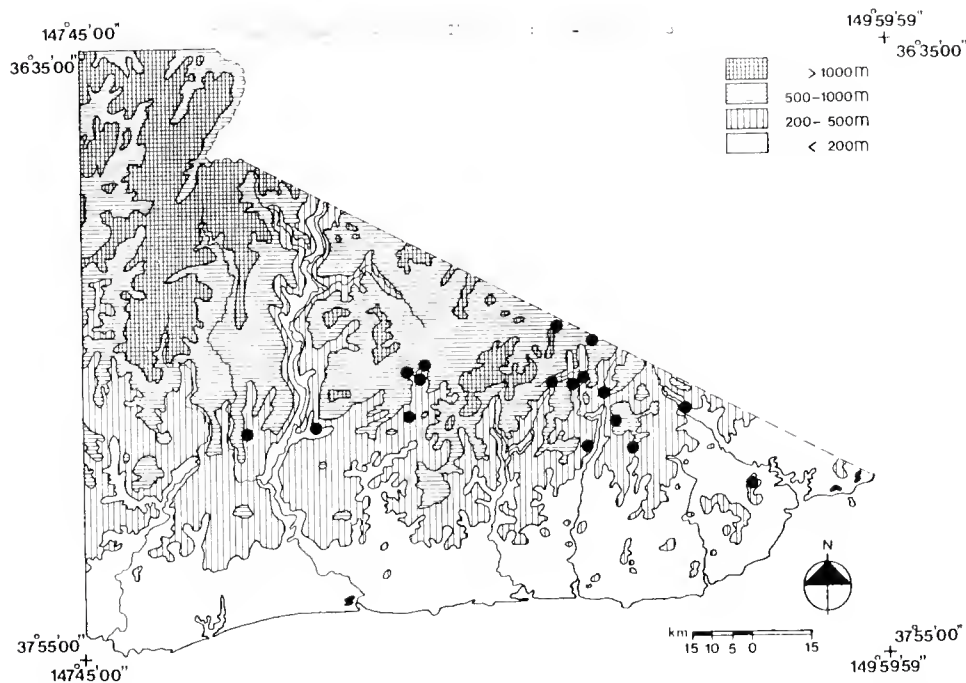
ALTITUDE: Mean = 727 m, Highest = 980 m, Lowest = 600 m.

STRUCTURE: Open-forest to Woodland

MEAN FLORISTIC RICHNESS: 38 species per site

MEAN WEED COMPOSITION: 2% of species, 2% of cover

NOTES: Although no eucalypt is characteristic, one or a number of species including *Eucalyptus cypellocarpa*, *E. dives*, *E. globulus*, *E. globocarpa*, *E. sieberi* and *E. macrohyncha* are present. *E. globulus*, a species often associated with mesic environments, occurs in quite xeric situations on ridges leading down to the Snowy River. *Cassinia longifolia* and leguminous species (*Indigofera australis*, *Pultenaea juniperina* and *Acacia dealbata*) provide a sparse shrub layer over a ground layer of herbs and semi-shrubs common on dry slopes. The three characteristic species of Epacridaceae provide a nectar resource. *Epacris impressa*, flowering through winter and spring is bird pollinated, whilst *Astroloma humifusum* (autumn-winter) and *Acrotriche serrulata* (spring) are pollinated by insects.



| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES            | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|--------------------------------|--------|-----|------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Lomandra longifolia</i>     | 94     | 1   | <i>Xanthonia pallida</i>     | 76     | 1   | <i>Dichelachne micrantha</i>   | 81     | +   |
| <i>Poa australis</i> spp. agg. | 94     | 1   | <i>Dianella revoluta</i>     | 76     | 1   | <i>Epacris impressa</i>        | 81     | 1   |
| <i>Dianella caerulea</i>       | 88     | 1   | <i>Astroloma humifusum</i>   | 71     | 1   | <i>Oxalis corniculata</i>      | 81     | +   |
| <i>Leucopogon lanceolatus</i>  | 88     | 1   | <i>Acrotriche serrulata</i>  | 71     | 1   | <i>Hydrocotyle hirta</i>       | 81     | +   |
| <i>Hypericum gramineum</i>     | 88     | +   | <i>Acacia mucronata</i>      | 65     | 1   | <i>Microlaena stipoides</i>    | 81     | +   |
| <i>Pteridium esculentum</i>    | 82     | 1   | <i>Gonocarpus tetragynus</i> | 65     | 1   | <i>Eucalyptus cypellocarpa</i> | 81     | 1   |
| <i>Eucalyptus globoidea</i>    | 76     | 2   | <i>Hibbertia obtusifolia</i> | 65     | 1   | <i>Exocarpos strictus</i>      | 81     | +   |
| <i>Helichrysum scorpioides</i> | 76     | +   | <i>Lepidosperma laterale</i> | 65     | 1   | <i>Persea linearis</i>         | 81     | 1   |

NO. OF SITES: 17 (2.9% of total)

DISTRIBUTION: Scattered through foothills of entire study area.

ENVIRONMENT: Clays on slopes and ridges

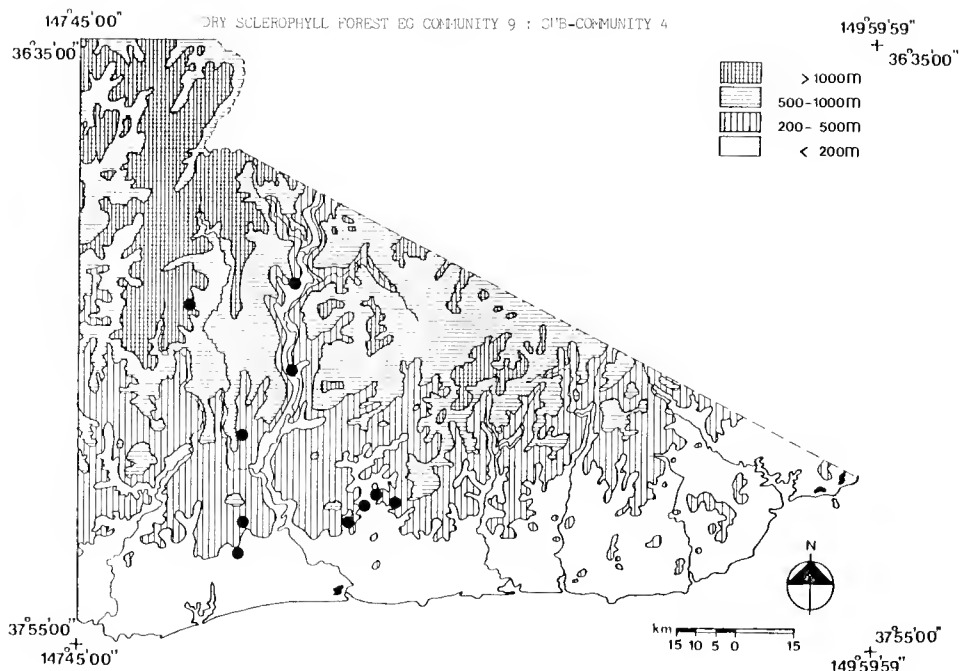
ALTITUDE: Mean = 373 m, Highest = 640 m, Lowest = 170 m.

STRUCTURE: Open-forest to Woodland

MEAN FLORESTIC RICHNESS: 46 species per site

MEAN WEED COMPOSITION: 1% of species, 1% of cover

NOTES: In contrast to other sub-communities of this community, a few shrubs other than the opportunistic species are significant. These include *Leucopogon lanceolatus*, *Persea linearis* and *Exocarpos strictus*. The ground layer consists of semi-shrubs and herbs common on dry slopes.



| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES            | % FREQ | C/A |
|--------------------------------|--------|-----|--------------------------------|--------|-----|------------------------------|--------|-----|
| <i>Eucalyptus globoidea</i>    | 100    | 1   | <i>Gonocarpus tetracoides</i>  | 78     | 1   | <i>Epacris impressa</i>      | 56     | +   |
| <i>Poa australis</i> spp. agg. | 100    | 1   | <i>Lomandra longifolia</i>     | 78     | 1   | <i>Lepidosperma laterale</i> | 56     | +   |
| <i>Viola hederacea</i>         | 89     | +   | <i>Pteridium esculentum</i>    | 78     | 1   | <i>Clematis aristata</i>     | 56     | +   |
| <i>Cassinia longifolia</i>     | 89     | 1   | <i>Eucalyptus cypellocarpa</i> | 67     | 1   | <i>Eucalyptus sieberi</i>    | 56     | 1   |
| <i>Dianella caerulea</i>       | 89     | +   | <i>Persoonia linearis</i>      | 67     | 1   | <i>Tetrarrhena juncea</i>    | 56     | 2   |

NO. OF SITES: 9 (1.5% of total)

DISTRIBUTION: Buchan, Buldah and Lungatta districts.

ENVIRONMENT: Siliceous runes on ridges and slopes of foothills

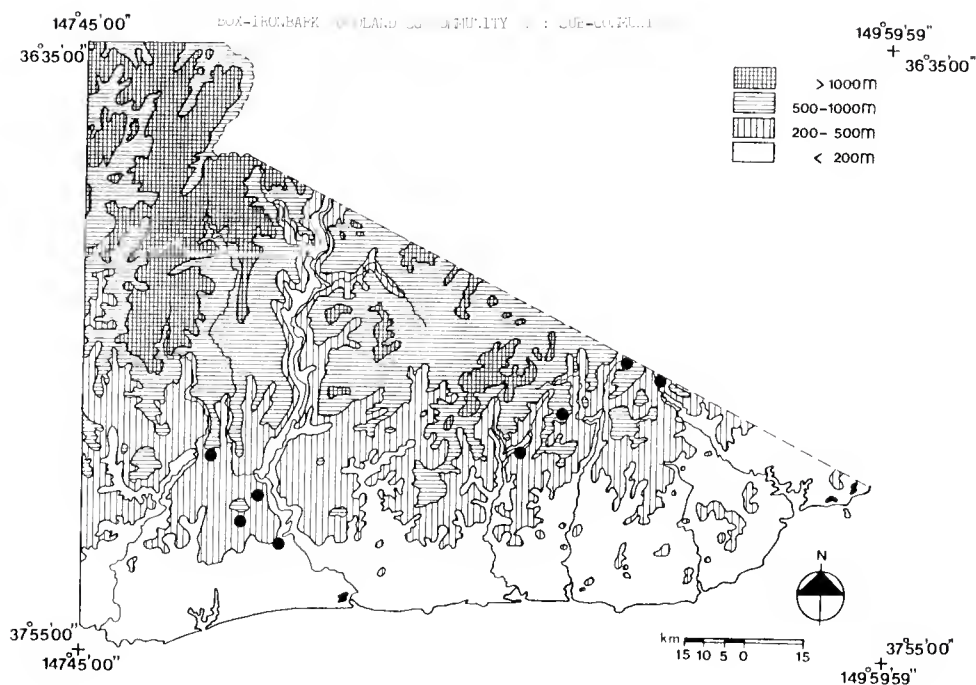
ALTITUDE: Mean = 351 m, Highest = 600 m, Lowest = 180 m.

STRUCTURE: Open-forest to Woodland

MEAN FLORISTIC RICHNESS: 40 species per site

MEAN WEED COMPOSITION: 1% of species, 1% of cover

NOTES: The characteristic species of this sub-community are widespread through eastern Victoria. An absence of dry slope peri-shrubs makes this sub-community structurally unusual amongst the foothill vegetation types. Although *Clematis aristata*, a characteristic species of this dry environment is usually a climber of wet environments, it's wind-borne, plumose seeds disperse it widely. The seedlings usually don't persist for more than a few years on dry slopes.



| CHARACTER SPECIES               | % FREQ | C/A | CHARACTER SPECIES             | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|---------------------------------|--------|-----|-------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Cassinia longifolia</i>      | 100    | 1   | <i>Eucalyptus sideroxylon</i> | 70     | 1   | <i>Wahlenbergia quadrifida</i> | 60     | +   |
| <i>Poa australis</i> spp. agg.  | 100    | 1   | <i>Eucalyptus globoidea</i>   | 70     | 1   | <i>Acacia mearnsii</i>         | 60     | 1   |
| <i>Acacia falciformis</i>       | 90     | 1   | <i>Oxalis corniculata</i>     | 70     | +   | <i>Correa reflexa</i>          | 60     | 1   |
| <i>Exocarpos cupressiformis</i> | 90     | 1   | <i>Lomandra longifolia</i>    | 70     | +   | <i>Microlaena stipoides</i>    | 60     | 1   |
| <i>Lepidosperma laterale</i>    | 90     | +   | <i>Billardiera scandens</i>   | 60     | +   | <i>Notelaea venosa</i>         | 60     | 1   |
| <i>Eucalyptus polyanthemus</i>  | 80     | 1   | <i>Hibbertia obtusifolia</i>  | 60     | +   |                                |        |     |

NO. OF SITES: 10 (1.7% of total)

DISTRIBUTION: Scattered in the Snowy and Timbarra River catchments.

ENVIRONMENT: Skeletal soils on dry, often north facing ridges and slopes.

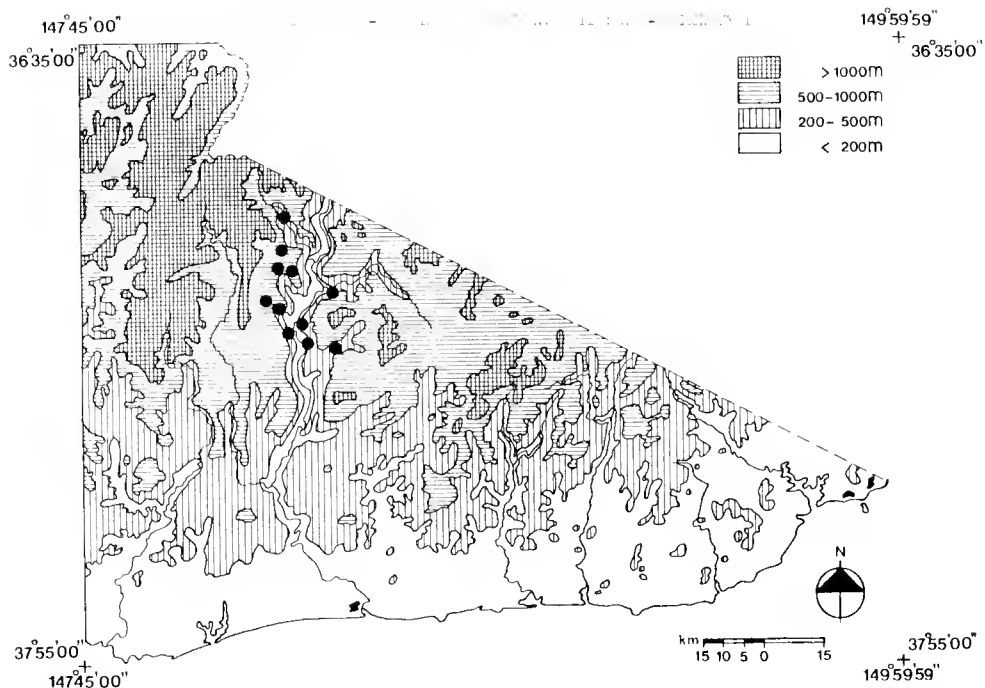
ALTITUDE: Mean = 239 m, Highest = 400 m, Lowest = 100 m.

STRUCTURE: Woodland

MEAN FLORISTIC RICHNESS: 48 species per site

MEAN WEED COMPOSITION: 1% of species, 0% of cover

NOTES: Other than the small trees *Acacia falciformis* and *Notelaea venosa*, the character species of this sub-community are widespread through Victorian foothills. *Eucalyptus polyanthemus* and *E. sideroxylon* are common on dry slopes in Central Victoria but are only occasional in East Gippsland. The ground layer consists of shrubs and herbs common on dry slopes. A surprising character species is *Notelaea venosa*, which shows optimal development in Victoria in warm temperate rainforest.



| CHARACTER SPECIES               | % FREQ | C/A | CHARACTER SPECIES               | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|---------------------------------|--------|-----|---------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Platyace lanceolata</i>      | 91     | 1   | <i>Brachyloma daphnoides</i>    | 64     | 1   | <i>Cassinia longifolia</i>     | 55     | +   |
| <i>Mimella revoluta</i>         | 73     | 1   | <i>Olearia iodoctirca</i>       | 64     | 1   | <i>Eucalyptus macrorhyncha</i> | 55     | 1   |
| <i>Eriostemon trachyphyllus</i> | 73     | 1   | <i>Tieghemopanax multifidus</i> | 64     | +   | <i>Eucalyptus sieberi</i>      | 55     | 2   |
| <i>Exocarpos cupressiformis</i> | 73     | 1   | <i>Acacia silvestris</i>        | 55     | 1   | <i>Persoonia confertiflora</i> | 55     | 1   |
| <i>Helichrysum obornatum</i>    | 73     | 1   | <i>Eucalyptus smithii</i>       | 55     | 1   | <i>Danthonia pallida</i>       | 55     | 1   |
| <i>Danthonia longifolia</i>     | 64     | 1   |                                 |        |     |                                |        |     |

NO. OF SITES: 11 (1.9% of total)

DISTRIBUTION: Confined to upper Snowy River district.

ENVIRONMENT: Rocky escarpments and exposed slopes with skeletal soils

ALTITUDE: Near = 140 m, Highest = 900 m, Lowest = 600 m.

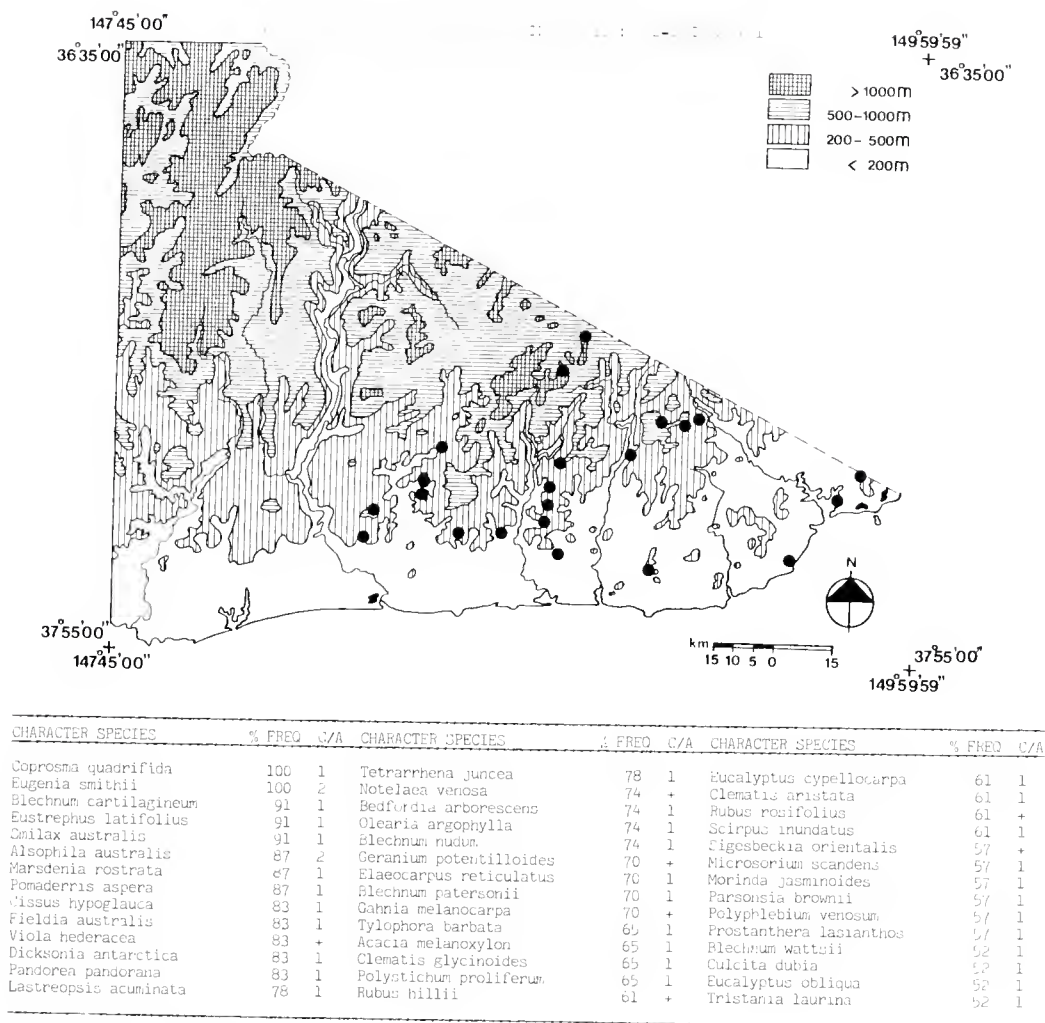
STRUCTURE: Tall shrubland to Closed scrub

MAX. FLORESTIC RICHNESS: 32 species per site

MAX. WEED COMPOSITION: 0% of species, 0% of cover

NOTE: Thickets without eucalypts may be characterized by *Eriostemon trachyphyllus* (locally "blackthorn scrub") or *Acacia silvestris*. In areas where this cover is unbroken, the number of species at a site may be as low as 8. Where eucalypts are present mallee, or low-branching, spindly forms of *Eucalyptus saxatilis*, *E. smithii*, *E. viminalis* and *E. glaucescens* predominate. *E. smithii* in this sub-community is generally that referred to by Kirkpatrick (1977) as *E. aff. smithii*. Cover may vary from very low values for all strata to being complete in the shrub layer. This sub-community is often found on rock crags with spectacular views. Significant species include *Melroydendron bauerianii*, *Phebalium lamprophyllum*, *Acrotriche divaricata*, *Bororia ledifolia*, *Dampiera pauraria*, *Gahnia microstachya* and *Goodenia heterophylla* and are almost restricted to this community. Its inopportune environment and lack of commercial value has precluded exploitation.





NO. OF SITES: 23 (3.9% of total)

DISTRIBUTION: Of restricted distribution west of the Snowy River but more common in the lowlands east to the Howe Range.

ENVIRONMENT: Sheltered gullies and alluvial flats associated with most river systems and their tributaries. Rich humic soils and rocky outcrops are common features

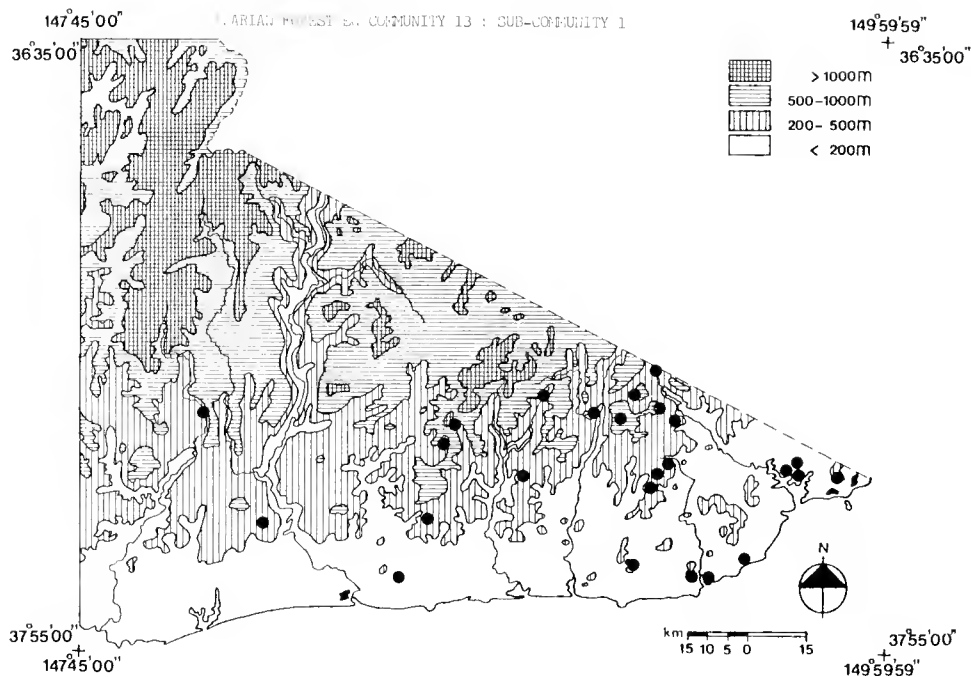
ALTITUDE: Mean = 234 m, Highest = 480 m, Lowest = 40 m.

STRUCTURE: Closed-forest

MEAN FLORISTIC RICHNESS: 58 species per site

MEAN WEED COMPOSITION: 2% of species, 1% of cover

NOTES: This sub-community forms one of few Victorian forest types not dominated by eucalypts. *Eugenia smithii* dominates the forest forming a conspicuous dark green closed canopy usually tangled with lianes (c.f. *Cissus hypoglauca*, *Marsdenia rostrata*, *Smilax australis*). Ferns are prominent beneath the canopy including arborescent forms (any of Victoria's 5 tree ferns), ground-forms (*Blechnum wattsi*, *B. cartilagineum*, *Lastreopsis acuminatum*) and epiphytes (*Microsorium scandens*, *M. diversifolium*, *Polyphlebium venosum*). These forests are near the southern limit of a vegetation-type common and extensive within tropical regions. A feature of the tropical rainforests however is a high species diversity within the tallest stratum, often more than 100 species per acre (Specht, 1970) (c.f. rarely more than 2 or 3 species of tree per site in 12.1).



| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|--------------------------------|--------|-----|--------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Tetrarrhena juncea</i>      | 36     | 1   | <i>Smilax australis</i>        | 68     | 1   | <i>Poa australis</i> spp. agg. | 57     | 1   |
| <i>Pteridium esculentum</i>    | 82     | 1   | <i>Elaeocarpus reticulatus</i> | 64     | 1   | <i>Pomaderris aspera</i>       | 54     | 1   |
| <i>Clematis aristata</i>       | 75     | 1   | <i>Goodenia ovata</i>          | 64     | 1   | <i>Leucopogon lanceolatus</i>  | 54     | 1   |
| <i>Eustrephus latifolius</i>   | 71     | +   | <i>Coprosma quadrifida</i>     | 61     | 1   | <i>Eucalyptus obliqua</i>      | 50     | 2   |
| <i>Lylophora barbata</i>       | 71     | 1   | <i>Blechnum cartilagineum</i>  | 61     | 1   | <i>Calceita dubia</i>          | 46     | 1   |
| <i>Eucalyptus tpyellocarpa</i> | 71     | 1   | <i>Alsophila australis</i>     | 61     | 1   | <i>Dianella caerulea</i>       | 46     | 1   |
| <i>Viola hederacea</i>         | 71     | +   | <i>Gonocarpus teucrioides</i>  | 57     | 1   | <i>Eucalyptus muelleriana</i>  | 46     | 1   |

NO. OF SITES: 26 (4.4% of total)

DISTRIBUTION: Rare west of the Snowy River but frequent in the lowlands and foothills east to the Howe Range.

ENVIRONMENT: Wet, south-facing slopes and gullies of lowland and foothills

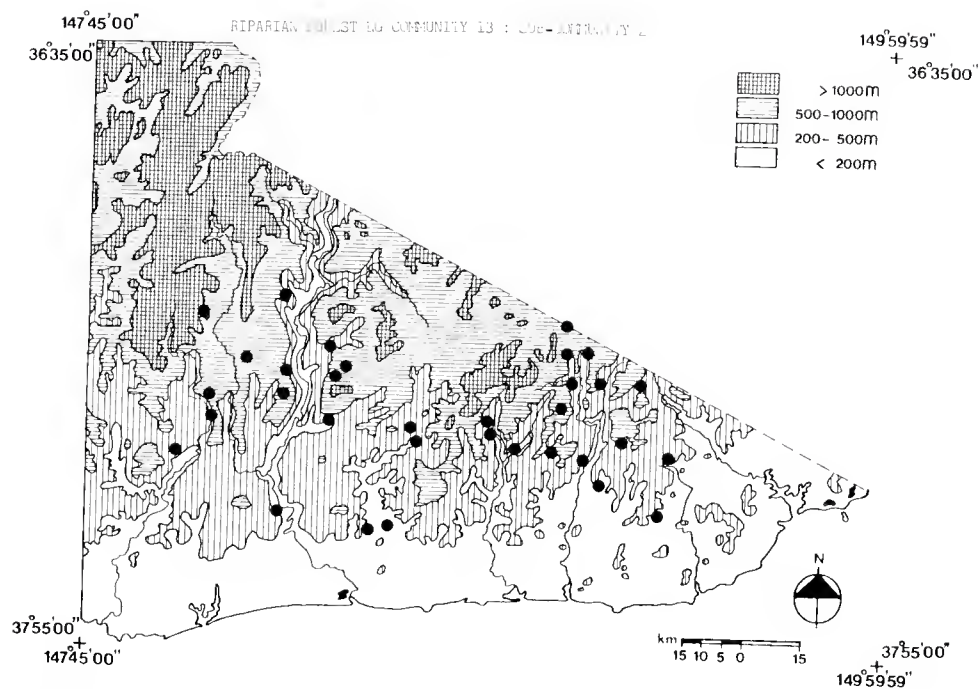
ALTITUDE: Mean = 298 m, Highest = 480 m, Lowest 40 m.

STRUCTURE: Open-forest

MEAN FLORISTIC RICHNESS: 48 species per site

MEAN WEED COMPOSITION: 0% of species, 0% of cover

NOTES: This sub-community has strong floristic affinities with 12.1 and the lowland wet-sclerophyll forests (13.2). In certain this represents a true ecotone between two vegetation types, but in areas which are occasionally burnt (particularly the lowlands), a "temporal ecotone" may exist in which the vegetation is in a successional state from sclerophyll-forest to *Eugenia smithii* closed-forest.



| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES                  | % FREQ | C/A | CHARACTER SPECIES            | % FREQ | C/A |
|--------------------------------|--------|-----|------------------------------------|--------|-----|------------------------------|--------|-----|
| <i>Pomaderris aspera</i>       | 85     | 1   | <i>Geranium potentilloides</i>     | 68     | +   | <i>Juncus plantifolius</i>   | 13     | +   |
| <i>Coprosma quadrifida</i>     | 79     | 1   | <i>Clematis aristata</i>           | 68     | +   | <i>Acacia dealbata</i>       | 50     | 1   |
| <i>Lomandra longifolia</i>     | 79     | 1   | <i>Gratiola peruviana</i>          | 68     | 1   | <i>Prunella vulgaris</i>     | 50     | 1   |
| <i>Pteridium esculentum</i>    | 79     | 1   | <i>Gnaphalium japonicum</i>        | 68     | +   | <i>Cassinia longifolia</i>   | 50     | 1   |
| <i>Blechnum nudum</i>          | 79     | 1   | <i>Carex appressa</i>              | 65     | 1   | <i>Tristania laurina</i>     | 50     | 1   |
| <i>Viola hederacea</i>         | 76     | +   | <i>Hydrocotyle hirta</i>           | 62     | +   | <i>Goodenia ovata</i>        | 47     | 1   |
| <i>Oxalis corniculata</i>      | 76     | +   | <i>Tetarrhena juncea</i>           | 62     | 1   | <i>Senecio linearifolius</i> | 47     | 1   |
| <i>Stellaria flaccida</i>      | 76     | 1   | <i>Leptospermum phylloides</i>     | 62     | 1   | <i>Dicksonia antarctica</i>  | 44     | 1   |
| <i>Microlaena stipoides</i>    | 76     | 1   | <i>Pimelea axiflora</i>            | 59     | 1   | <i>*Cirsium vulgare</i>      | 44     | +   |
| <i>Scirpus inundatus</i>       | 76     | 1   | <i>Dianella tasmanica</i>          | 56     | 1   | <i>Blechnum minus</i>        | 44     | 1   |
| <i>Acacia melanoxylon</i>      | 76     | 1   | <i>Cassinia aculeata</i>           | 56     | +   | <i>Lepidosperma laterale</i> | 44     | 1   |
| <i>Adiantum aethiopicum</i>    | 74     | 1   | <i>Bursaria spinosa</i>            | 56     | 1   | <i>Eucalyptus viminalis</i>  | 44     | 1   |
| <i>Poa australis</i> spp. agg. | 71     | 1   | <i>Eucalyptus cypellocharpa</i>    | 53     | 1   | <i>Goodia lotifolia</i>      | 44     | +   |
| <i>Acaena anserinifolia</i>    | 71     | +   | <i>Culcita dubia</i>               | 53     | 1   | <i>Lomatia myricoides</i>    | 44     | 1   |
| <i>*Hypochoeris radicata</i>   | 71     | +   | <i>Alsophila australis</i>         | 53     | 1   | <i>Olearia lirata</i>        | 44     | +   |
| <i>Prostanthera lasiantha</i>  | 68     | 1   | <i>*Rubus fruticosus</i> spp. agg. | 53     | 1   |                              |        |     |

NO. OF SITES: 33 (5.6% of total)

DISTRIBUTION: Common throughout regions more than 20 km inland but not in the alps, subalps or the rainshadow area of the upper Snowy River.

ENVIRONMENT: Gently falling, mid-altitude waterways. Alluvial soils and granitic sands interspersed with boulders generally comprise the substrate

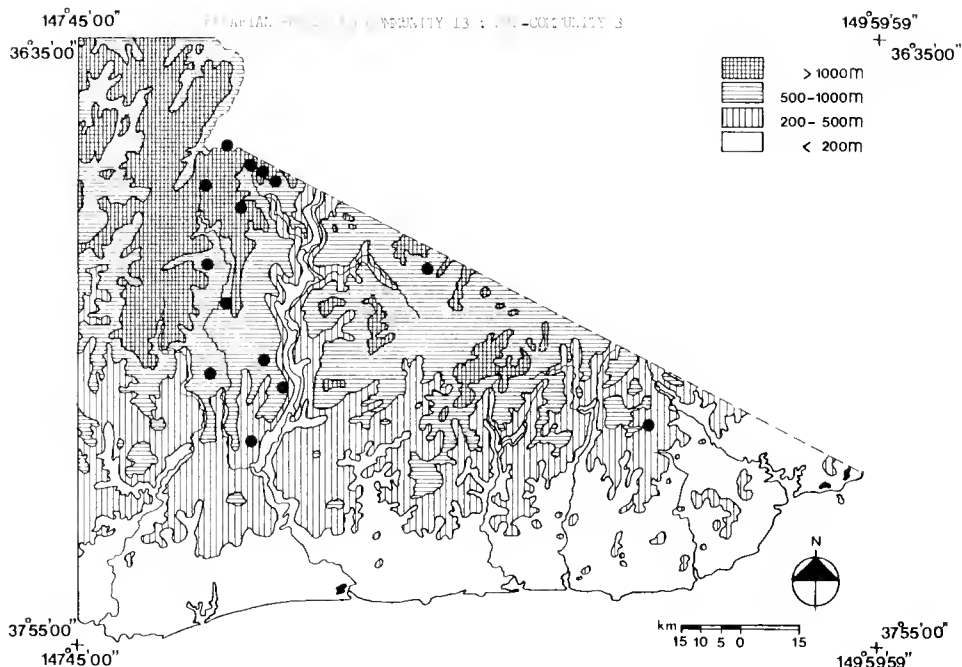
ALTITUDE: Mean = 292 m, Highest = 700 m, Lowest = 80 m.

STRUCTURE: Open-forest

MEAN FLORISTIC RICHNESS: 67 species per site

MEAN WEED COMPOSITION: 7% of species, 6% of cover

NOTES: High floristic richness is a feature of riparian vegetation and this sub-community has the highest mean number of species per site of any encountered in the study. Soil nutrients are concentrated in river valleys and water availability is rarely a limiting factor to plants of this environment. Seeds of plants, including weeds, are also concentrated near rivers, and moderately high numbers of weeds are not necessarily indicative of disturbance near the sampled site. 13.2 is an example of this process.



| CHARACTER SPECIES                   | % FREQ | C/A | CHARACTER SPECIES                 | % FREQ | C/A | CHARACTER SPECIES           | % FREQ | C/A |
|-------------------------------------|--------|-----|-----------------------------------|--------|-----|-----------------------------|--------|-----|
| <i>Lomandra longifolia</i>          | 100    | 1   | <i>Poa australis</i> spp. agg.    | 67     | 1   | <i>Holcus lanatus</i>       | 60     | +   |
| * <i>Hypochoeris radicata</i>       | 93     | 1   | <i>Prunella vulgaris</i>          | 67     | 1   | <i>Hypericum japonicum</i>  | 60     | +   |
| * <i>Rubus fruticosus</i> spp. agg. | 73     | 1   | <i>Acaena anserinifolia</i>       | 67     | 1   | <i>Pomaderris aspera</i>    | 53     | 1   |
| <i>Acacia melanoxylon</i>           | 73     | 1   | <i>Carex appressa</i>             | 67     | 1   | <i>Epilobium cinereum</i>   | 53     | 1   |
| * <i>Centaurium pulchellum</i>      | 73     | 1   | <i>Agrostis avenacea</i>          | 67     | +   | * <i>Rosa rubiginosa</i>    | 53     | 1   |
| <i>Geranium potentilloides</i>      | 73     | +   | <i>Leptospermum phyllicoides</i>  | 67     | 1   | * <i>Trifolium repens</i>   | 53     | 1   |
| <i>Gratiola peruviana</i>           | 73     | 1   | <i>Lomatia myricoides</i>         | 60     | 1   | <i>Cyperus lucidus</i>      | 53     | 1   |
| <i>Acacia dealbata</i>              | 67     | 1   | <i>Hydrocotyle sibthorpioides</i> | 60     | 1   | <i>Polygonum hydropiper</i> | 53     | +   |
| <i>Carex gaudichaundiana</i>        | 67     | 1   | <i>Rumex brownii</i>              | 60     | 1   | <i>Juncus</i> spp.          | 53     | 1   |
| <i>Gnaphalium japonicum</i>         | 67     | 1   |                                   |        |     |                             |        |     |

NO. OF SITES: 14 (2.6% of total)

DISTRIBUTION: Along the banks of the upper-Snowy and Buchan Rivers with one site beside the Genoa River near Wangarabell.

ENVIRONMENT: Banks of rivers flowing through dry, open-forest areas. Seasonal flooding forms banks of alluvial sands in some areas. Granite or sandstone boulders are common features of these shores

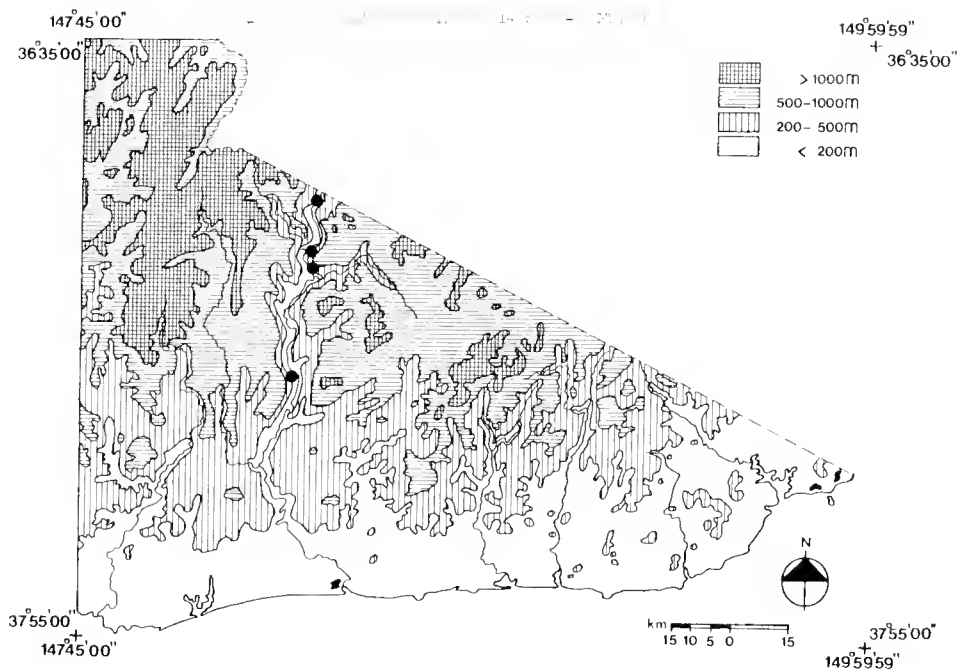
ALTITUDE: Mean = 529 m, Highest = 760 m, Lowest = 160 m.

STRUCTURE: Woodland

MEAN FLORISTIC RICHNESS: 60 species per site

MEAN WEED COMPOSITION: 15% of species, 15% of cover

NOTES: A riparian vegetation-type of drier, more open areas than 13.2. Many areas in the vicinity of this sub-community have been converted to agricultural land and this influence is responsible for the high weed numbers of 13.3.



| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES               | % FREQ | C/A | CHARACTER SPECIES             | % FREQ | C/A |
|--------------------------------|--------|-----|---------------------------------|--------|-----|-------------------------------|--------|-----|
| <i>Acacia boormanii</i>        | 100    | 1   | <i>Lissanthe strigosa</i>       | 75     | 1   | * <i>Conyza bonariensis</i>   | 75     | 1   |
| * <i>Hypochoeris radicata</i>  | 100    | +   | <i>Acacia dealbata</i>          | 75     | 1   | <i>Eucalyptus blakelyi</i>    | 75     | 1   |
| <i>Leptospermum phylloides</i> | 100    | -   | <i>Arthropodium milleflorum</i> | 75     | +   | <i>Gnaphalium luteoalbum</i>  | 75     | +   |
| * <i>Verbascum thapsus</i>     | 100    | +   | <i>Calytrix tetragona</i>       | 75     | 1   | * <i>Hirschfeldia incana</i>  | 75     | +   |
| <i>Acacia mearnsii</i>         | 75     | 1   | <i>Cheilanthes tenuifolia</i>   | 75     | 1   | * <i>Petrohragia velutina</i> | 75     | +   |
| <i>Dodonaea viscosa</i>        | 75     | 1   |                                 |        |     |                               |        |     |

NO. OF SITES: 4 (7.7% of total)

DISTRIBUTION: Restricted to the upper Snowy River, but common from the border downstream to near New Olneya.

ENVIRONMENT: Coarse alluvial sands beside the river. Sites sampled are within the north-eastern rainshadow zone (mean annual rainfall less than 800 mm). Flooding of the river is a common occurrence.

ALTITUDE: Mean = 170 m, Highest = 210 m, Lowest = 100 m.

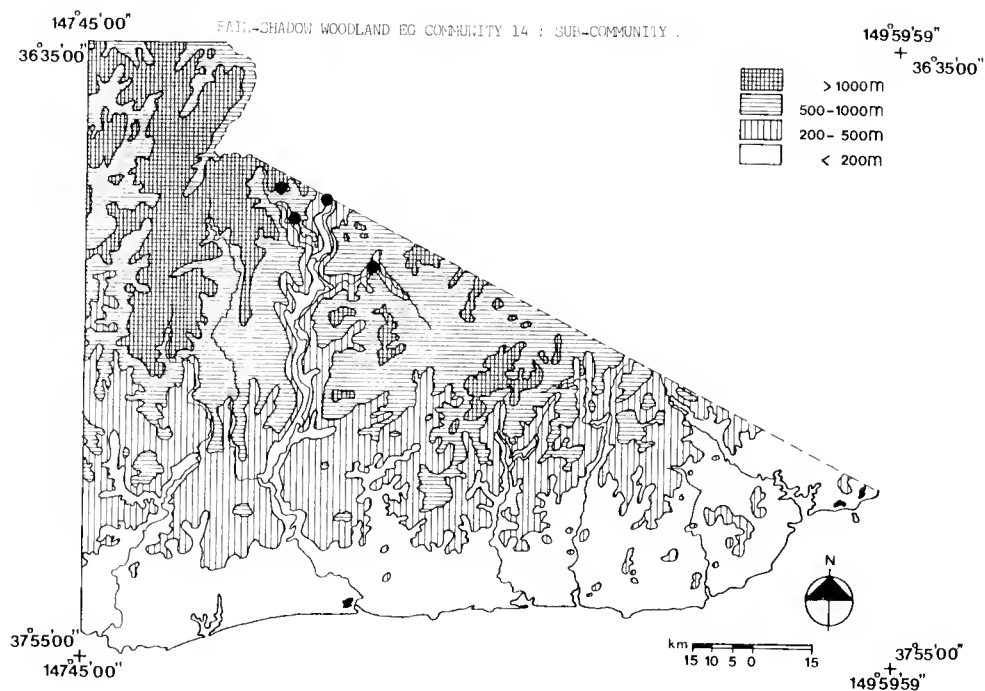
STRUCTURE: Woodland

MEAN FLORISTIC RICHNESS: 54 species per site

MEAN WEED COMPOSITION: 32% of species, 27% of cover

NOTES: Short-lived species, particularly weeds (*Verbascum thapsus*, *Petrohragia velutina*, *Hirschfeldia incana*), capable of completing their life-cycle between flood periods, are common in this sub-community. Other woody species (*Leptospermum phylloides*, *Calytrix tetragona*, *Eucalyptus blakelyi*) are often contorted by successive flooding of the river. Above the flood-prone section of the bank species characteristic of the surrounding woodlands are common.





| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES            | % FREQ | C/A | CHARACTER SPECIES            | % FREQ | C/A |
|--------------------------------|--------|-----|------------------------------|--------|-----|------------------------------|--------|-----|
| <i>Agropyron scabrum</i>       | 100    | 1   | <i>Aristida ramosa</i>       | 75     | 1   | <i>Hardenbergia violacea</i> | 75     | +   |
| <i>Cheilanthes tenuifolia</i>  | 100    | 1   | <i>Cheilanthes distans</i>   | 75     | +   | <i>Lissanthe strigosa</i>    | 75     | 1   |
| <i>Eucalyptus albens</i>       | 100    | 1   | <i>Danthonia racemosa</i>    | 75     | 1   | <i>Melichrus urceolatus</i>  | 75     | 1   |
| <i>Foa australis</i> spp. aff. | 100    | 1   | <i>Dichanthium sericeum</i>  | 75     | +   | <i>Oxalis corniculata</i>    | 75     | +   |
| <i>Glenatis microphylla</i>    | 75     | 1   | <i>Dichelachne crinita</i>   | 75     | +   | <i>Stellaria pungens</i>     | 75     | 1   |
| <i>Cymbopogon refractus</i>    | 75     | 1   | <i>Dichondra repens</i>      | 75     | +   | <i>Themeda australis</i>     | 75     | 2   |
| <i>Lomandra longifolia</i>     | 75     | +   | <i>Dodonaea angustissima</i> | 75     | +   | <i>Vittadinia triloba</i>    | 75     | 1   |
| <i>Acacia implexa</i>          | 75     | 1   | <i>Enneapogon nigricans</i>  | 75     | 1   |                              |        |     |

NO. of SITES: 1 (0.7% of total)

DISTRIBUTION: Areas surrounding the upper Snowy River and its tributaries; particularly near Willis, Suggan Buggan and Tubbut.

ENVIRONMENT: Dry, often steep slopes (mean annual rainfall less than 700 mm) of gravelly soils with frequent granite outcrops.

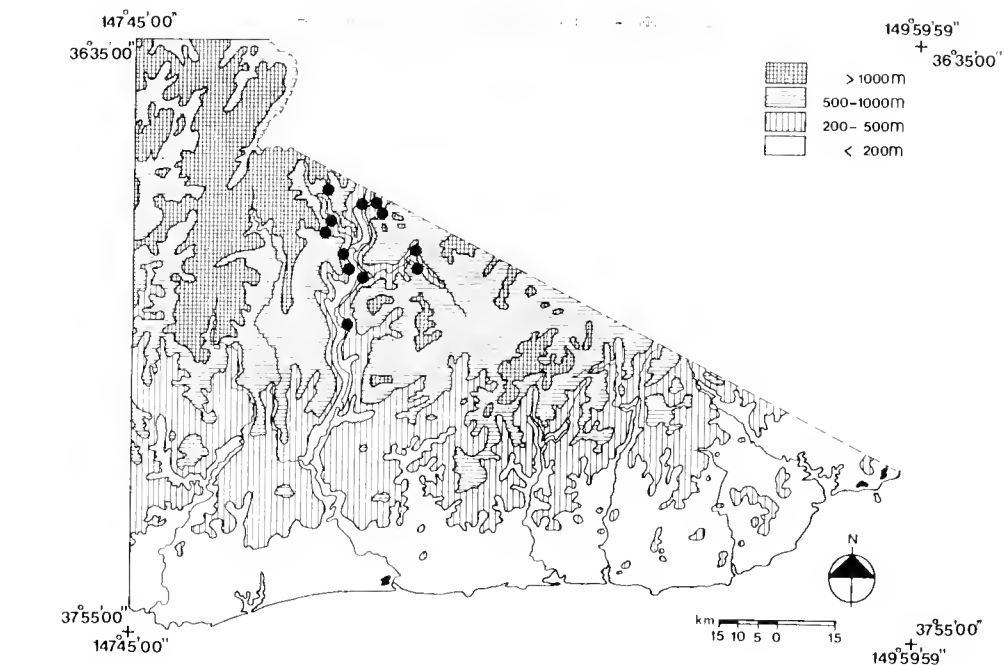
ALTITUDE: Mean = 590 m, Highest = 800 m, Lowest = 320 m.

STRUCTURE: Grassy low-woodland

MEAN FLORESTIC RICHNESS: 44 species per site

MEAN WEED COMPOSITION: % of species, % of cover

NOTE: A unique vegetation type in eastern Victoria which includes grasses common in the Central and Northern Plains (*Aristida ramosa*, *Dichanthium sericeum*, *Enneapogon nigricans*) but which are not frequent in Gippsland. Species other than grasses possess physical and physiological adaptations to the dry, nutrient-poor environment such as small sclerophyllous foliage (e.g. the heaths *Melichrus urceolatus*, *Lissanthe strigosa*) and an ability to rapidly respond to sporadic rains (e.g. *Cheilanthes tenuifolia*, a resurrection fern). The extent and floristic integrity of this sub-community has been severely reduced as a result of grazing.



| CHARACTER SPECIES              | FRAG. COA | CHARACTER SPECIES               | FRAG. COA | CHARACTER SPECIES              | FRAG. COA |
|--------------------------------|-----------|---------------------------------|-----------|--------------------------------|-----------|
| <i>Clematis microphylla</i>    | 1/2       | <i>Agropyron sibiricum</i>      | 3         | <i>Geilanthus tenuifolia</i>   | 60        |
| <i>Eucalyptus albans</i>       | 43        | <i>Cymbopogon prostratus</i>    | 1         | <i>Brachyantha populnea</i>    | 60        |
| <i>Lissanthe strigosa</i>      | 43        | <i>Aster loma humilis</i>       | 1         | <i>Hydrocotyle filifera</i>    | 43        |
| <i>Poa australis</i> spp. agg. | 57        | <i>Lichandra repens</i>         | 1         | <i>Callitriche callunoides</i> | 43        |
| * <i>Pentstemon pulchellus</i> | 73        | <i>Conoclinium pinnatifidum</i> | 60        | <i>Geranium robertianum</i>    | 43        |

FRAG. COA: 147°45'00" 36°35'00"

CHARACTER SPECIES: *Agropyron sibiricum*, *Cymbopogon prostratus*, *Aster loma humilis*, *Lichandra repens*, *Conoclinium pinnatifidum*, *Geranium robertianum*, *Callitriche callunoides*, *Hydrocotyle filifera*, *Brachyantha populnea*, *Geilanthus tenuifolia*, *Poa australis* spp. agg., *Lissanthe strigosa*, *Eucalyptus albans*, *Clematis microphylla*, *Pentstemon pulchellus*.

CHARACTER SPECIES: *Agropyron sibiricum*, *Cymbopogon prostratus*, *Aster loma humilis*, *Lichandra repens*, *Conoclinium pinnatifidum*, *Geranium robertianum*, *Callitriche callunoides*, *Hydrocotyle filifera*, *Brachyantha populnea*, *Geilanthus tenuifolia*, *Poa australis* spp. agg., *Lissanthe strigosa*, *Eucalyptus albans*, *Clematis microphylla*, *Pentstemon pulchellus*.

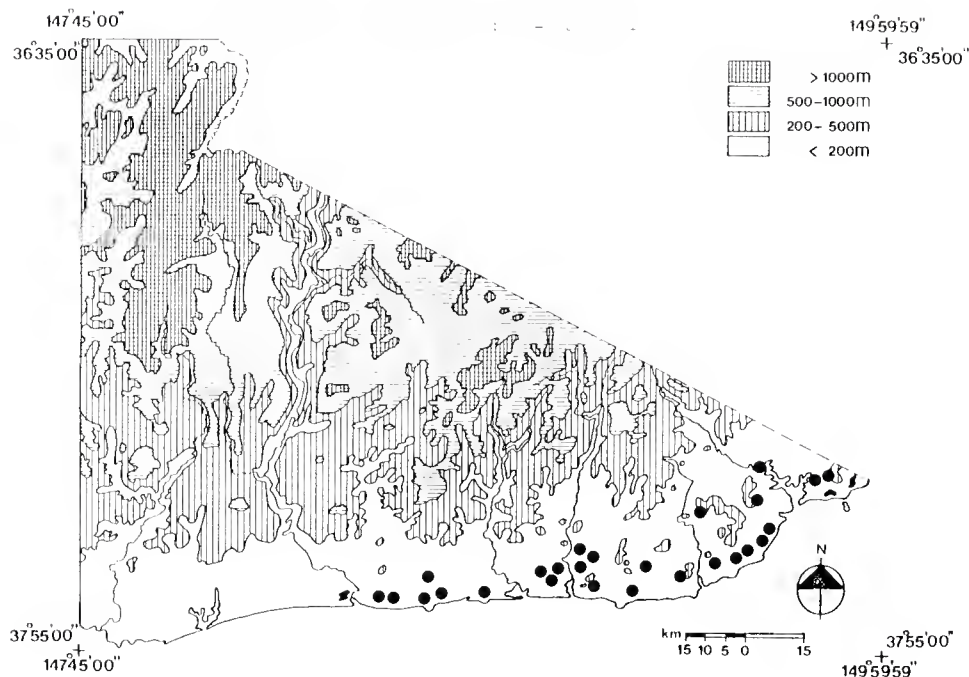
CHARACTER SPECIES: *Agropyron sibiricum*, *Cymbopogon prostratus*, *Aster loma humilis*, *Lichandra repens*, *Conoclinium pinnatifidum*, *Geranium robertianum*, *Callitriche callunoides*, *Hydrocotyle filifera*, *Brachyantha populnea*, *Geilanthus tenuifolia*, *Poa australis* spp. agg., *Lissanthe strigosa*, *Eucalyptus albans*, *Clematis microphylla*, *Pentstemon pulchellus*.

CHARACTER SPECIES: *Agropyron sibiricum*, *Cymbopogon prostratus*, *Aster loma humilis*, *Lichandra repens*, *Conoclinium pinnatifidum*, *Geranium robertianum*, *Callitriche callunoides*, *Hydrocotyle filifera*, *Brachyantha populnea*, *Geilanthus tenuifolia*, *Poa australis* spp. agg., *Lissanthe strigosa*, *Eucalyptus albans*, *Clematis microphylla*, *Pentstemon pulchellus*.

CHARACTER SPECIES: *Agropyron sibiricum*, *Cymbopogon prostratus*, *Aster loma humilis*, *Lichandra repens*, *Conoclinium pinnatifidum*, *Geranium robertianum*, *Callitriche callunoides*, *Hydrocotyle filifera*, *Brachyantha populnea*, *Geilanthus tenuifolia*, *Poa australis* spp. agg., *Lissanthe strigosa*, *Eucalyptus albans*, *Clematis microphylla*, *Pentstemon pulchellus*.

CHARACTER SPECIES: *Agropyron sibiricum*, *Cymbopogon prostratus*, *Aster loma humilis*, *Lichandra repens*, *Conoclinium pinnatifidum*, *Geranium robertianum*, *Callitriche callunoides*, *Hydrocotyle filifera*, *Brachyantha populnea*, *Geilanthus tenuifolia*, *Poa australis* spp. agg., *Lissanthe strigosa*, *Eucalyptus albans*, *Clematis microphylla*, *Pentstemon pulchellus*.

CHARACTER SPECIES: *Agropyron sibiricum*, *Cymbopogon prostratus*, *Aster loma humilis*, *Lichandra repens*, *Conoclinium pinnatifidum*, *Geranium robertianum*, *Callitriche callunoides*, *Hydrocotyle filifera*, *Brachyantha populnea*, *Geilanthus tenuifolia*, *Poa australis* spp. agg., *Lissanthe strigosa*, *Eucalyptus albans*, *Clematis microphylla*, *Pentstemon pulchellus*. The map shows a river network and elevation contours. A legend indicates elevation ranges: > 1000m (cross-hatched), 500-1000m (horizontal lines), 200-500m (vertical lines), and < 200m (white). A scale bar shows 0 to 15 km. A north arrow is present. The map is labeled with coordinates at the corners: 147°45'00" 36°35'00" (top-left), 149°59'59" 36°35'00" (top-right), 147°45'00" 37°55'00" (bottom-left), and 149°59'59" 37°55'00" (bottom-right).



| CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES               | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|--------------------------------|--------|-----|---------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Xanthosia serrata</i>       | 93     | 1   | <i>Xanthosia pilosa</i>         | 83     | 1   | <i>Patersonia glabrata</i>     | 60     | 1   |
| <i>Epacris impressa</i>        | 90     | 1   | <i>Leptospermum juniperinum</i> | 83     | 1   | <i>Anisopogon avenaceus</i>    | 60     | 1   |
| <i>Amperea xiphoclada</i>      | 87     | 1   | <i>Dillwynia glaberrima</i>     | 80     | 1   | <i>Leucopogon collinus</i>     | 57     | 1   |
| <i>Dampiera stricta</i>        | 87     | 1   | <i>Lomandra longifolia</i>      | 77     | 1   | <i>Tetratheca pilosa</i>       | 57     | 1   |
| <i>Stylidium ericoides</i>     | 87     | 1   | <i>Acacia terminalis</i>        | 77     | 1   | <i>Monotoca scoparia</i>       | 53     | +   |
| <i>Horridula aculeatum</i>     | 87     | 1   | <i>Correa reflexa</i>           | 73     | 1   | <i>Leptospermum attenuatum</i> | 53     | 1   |
| <i>Platytha glabella</i>       | 87     | 1   | <i>Lepidosperma concavum</i>    | 63     | 1   | <i>Platylebium formosum</i>    | 50     | 1   |
| <i>Platycarpus pinnifolius</i> | 83     | 1   | <i>Acacia suaveolens</i>        | 63     | 1   | <i>Surchardia umbellata</i>    | 47     | +   |
| <i>Amperea tetracoides</i>     | 83     | 1   | <i>Pimelea linifolia</i>        | 63     | 1   | <i>Selaginella uliginosa</i>   | 47     | 1   |

Percentage: 30 (1% of total)

Location: Coastal lowlands from the Snowy River east to the Victoria-N.S.W. border.

Site: Inland from full oceanic influence, on siliceous sands

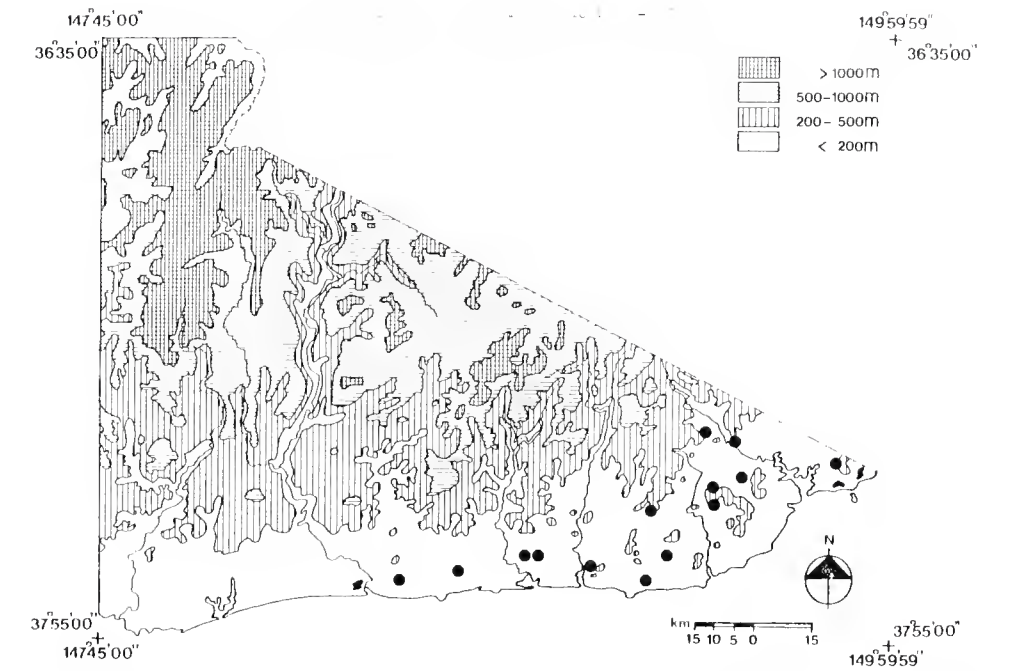
Altitude: Mean = 61 m, Highest = 180 m, Lowest = 0 m.

Vegetation: Woodland

Number of sites: 52 species per site

Number of species: 0% of species, 0% of cover

Notes: Although no single species of eucalypt occurs in more than 30% of these sites, one or more species are usually present (e.g. *Eucalyptus globoides*, *E. gummitera*, *E. nitens*, *E. consideniana*, *E. muelleriana* or *E. borrioides*). *E. gummitera* has its most southerly occurrence in far East Gippsland, and is Victoria's only member of the bloodwood group. A diverse shrub layer of small-leaved, sclerophyllous species is present (e.g. *Epacris impressa*, *Leptospermum juniperinum*) above a ground layer of monocotyledons (e.g. *Lepidosperma concavum*, *Anisopogon avenaceus*) and semi-shrubs (e.g. *Dampiera stricta*, *Amperea xiphoclada*). Areas of restricted drainage are indicated by the presence of *Selaginella uliginosa* and *Melaleuca squarrosa* in some quadrats. This woodland has little presently merchantable timber.



| CHARACTER SPECIES       | % FRQ. | C/A | CHARACTER SPECIES        | % FRQ. | C/A | CHARACTER SPECIES        | % FRQ. | C/A |
|-------------------------|--------|-----|--------------------------|--------|-----|--------------------------|--------|-----|
| Acacia terminalis       | 100    | 1   | Eucalyptus globulesa     | 86     | 1   | Boa australis            | 84     | 1   |
| Pteridium caudulentum   | 100    | 1   | Lomandra longifolia      | 86     | 1   | Sibbieria angustifolia   | 84     | 1   |
| Tetrastichia pilosa     | 100    | 1   | Antrodia pilosa          | 86     | 1   | Leptospermum laurifolium | 84     | 1   |
| Epacris impressa        | 93     | 1   | Leptanthus unicus        | 73     | 1   | Patersonia glabrata      | 84     | 1   |
| Platylobium formosum    | 93     | 1   | Andropogon avenaceus     | 73     | 1   | Platysace lanceolata     | 84     | 1   |
| Amperea xiphioides      | 93     | 1   | Callitriche glaberrima   | 73     | 1   | Hydrocotyle pinnatifida  | 84     | 1   |
| Aotus cricoides         | 93     | 1   | Periconia linearis       | 73     | 1   | Sillanthera scandens     | 84     | 1   |
| Bankia serrata          | 93     | 1   | Pinus laevis             | 73     | 1   | Loranthus filicifolius   | 84     | 1   |
| Juniperus stricta       | 93     | 1   | Cassiopea glabella       | 71     | +   | Leucosia racemosa        | 84     | 1   |
| Mianella caerulea       | 93     | 1   | Eucalyptus sieberi       | 71     | +   | Eucalyptus laevis        | 84     | 1   |
| Conocarpus tetraloideus | 93     | 1   | Leptospermum laurifolium | 71     | 1   | Leptospermum attenuatum  | 84     | 1   |

NO. OF SITES: 14 (1.4% of total)

DISTRIBUTION: Coastal lowlands and foothills from the Snowy River east to the Victorian-S.W. border.

ENVIRONMENT: Siliceous sands

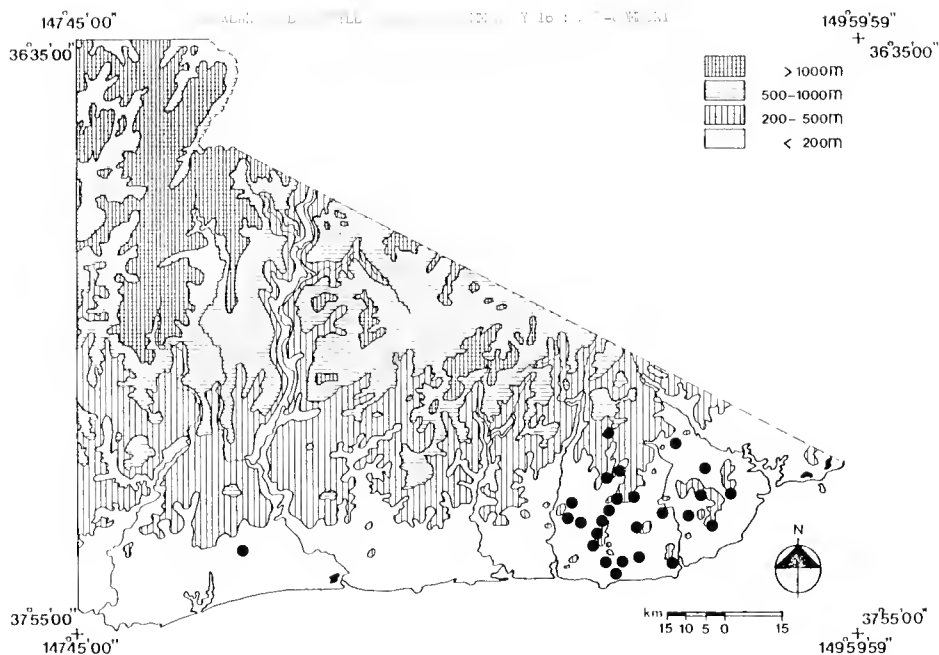
ALTITUDE: Mean = 91 m, Highest = 100 m, Lowest = 40 m.

STRUCTURE: Open-forest

MEAN FLORISTIC RICHNESS: 46 species per site

PLANT WEED COMPOSITION: 0% of species, 0% of cover

NOTES: Sub-community level is floristically intermediate between sub-community level 1 and level 2. This community is grouped with Lowland Eucalyptus forest because of its structural similarity with that community (i.e. a high cover and consistent occurrence of eucalypt).



| CHARACTER SPECIES             | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES               | % FREQ | C/A |
|-------------------------------|--------|-----|--------------------------------|--------|-----|---------------------------------|--------|-----|
| <i>Epacris impressa</i>       | 93     | 1   | <i>Lepidosperma laterale</i>   | 81     | 1   | <i>Pterocarya glabrata</i>      | 59     | 1   |
| <i>Monocarpus teucrioides</i> | 93     | 1   | <i>Tetratheca pilosa</i>       | 78     | 1   | <i>Lomandra longifolia</i>      | 59     | 1   |
| <i>Persoonia linearis</i>     | 93     | 1   | <i>Banksia serrata</i>         | 74     | 1   | <i>Anisopogon avenaceus</i>     | 56     | +   |
| <i>Platylobium tomentosum</i> | 93     | 1   | <i>Poa australis</i> spp. agg. | 70     | 1   | <i>Cassytha phaeolasia</i>      | 56     | 1   |
| <i>Amperea xiphioloba</i>     | 89     | +   | <i>Acacia terminalis</i>       | 67     | 1   | <i>Pimelea humilis</i>          | 56     | +   |
| <i>Diarella coerulescens</i>  | 89     | 1   | <i>Eucalyptus globoides</i>    | 67     | 1   | <i>Banksia spinulosa</i>        | 56     | 1   |
| <i>Lomatia ilicifolia</i>     | 89     | 1   | <i>Acacia myrtifolia</i>       | 67     | 1   | <i>Leptospermum juniperinum</i> | 52     | +   |
| <i>Eucalyptus sieberi</i>     | 85     | 2   | <i>Lindraya linearis</i>       | 63     | +   | <i>Danthonia pallida</i>        | 52     | 1   |
| <i>Pteridium esculentum</i>   | 85     | 1   | <i>Hakea sericea</i>           | 63     | 1   | <i>Correa reflexa</i>           | 48     | +   |
| <i>Dampiera stricta</i>       | 85     | 1   | <i>Scaevola ramosissima</i>    | 63     | 1   | <i>Lycopodium deuterodensum</i> | 48     | 1   |
| <i>Tetrarrhena juncea</i>     | 85     | 1   | <i>Billardiera scandens</i>    | 63     | +   | <i>Eucalyptus considenlora</i>  | 48     | 1   |
| <i>Caustis flexuosa</i>       | 81     | 1   | <i>Burchardia umbellata</i>    | 63     | +   | <i>Xanthosia tridentata</i>     | 48     | +   |
| <i>Gibbertia empetrifolia</i> | 81     | 1   |                                |        |     |                                 |        |     |

NO. OF SITES: 17 (4.6% of total)

DISTRIBUTION: Coastal lowland, mainly of Murrumbidgee and Cann River districts, also an isolated occurrence near Toowoomba

ENVIRONMENT: Shrubland

ALTITUDE: Mean = 137 m, Highest = 320 m, Lowest = 60 m

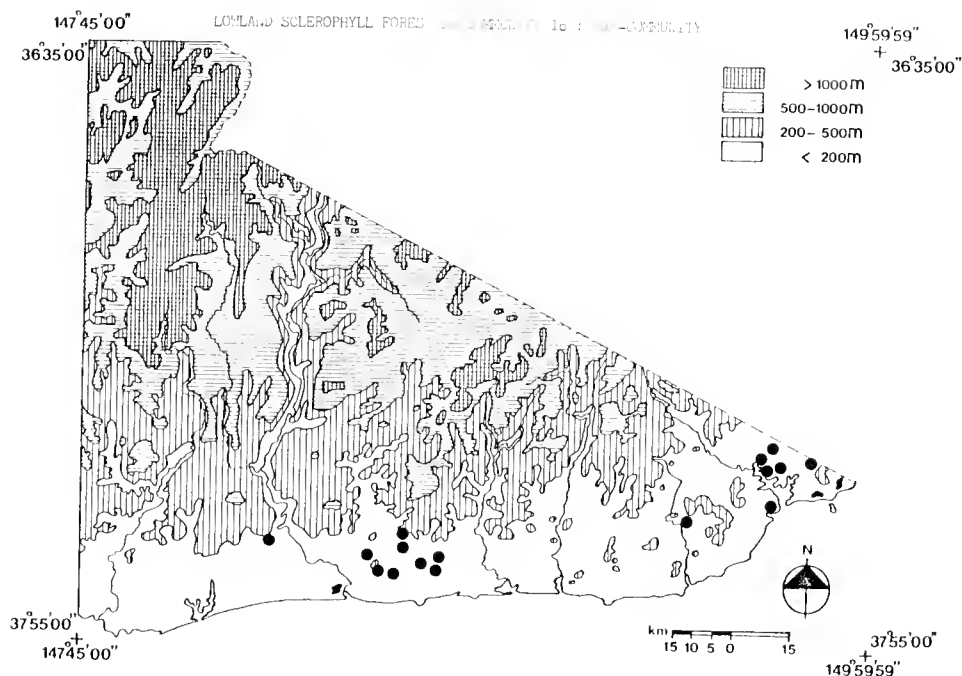
STRUCTURE: Open-forest

MEAN FLORENTIC RICHNESS: 50 species per site

MEAN WEED COMPOSITION: 0% of species, 0% of cover

NOTE: The understory of this sub-community forms an open scrub above a shrub layer typical of Lowland sclerophyllous forest. The scrub is mostly comprised of members of the Proteaceae. These are significant for nectariferous animals, supplying nectar through much of the year. *Banksia spinulosa* is winter flowering, *Hakea sericea* flowers in spring, whilst *B. serrata* and *Persoonia linearis* flower in summer. Monocotyledons and semi-shrubs, including showy-flowering species such as *Dampiera stricta* and *Scaevola ramosissima* make up the ground layer. Of the four species of grass, the scrambling wire grass, *Tetrarrhena juncea*, and the broad-leaved oat spear grasses *Danthonia pallida* and *Poa australis* spp. agg. may be confused with each other. *Lycopodium deuterodensum* may grow to 1 m and has the appearance of a small pine tree. It is a member of the primitive Lycopodiaceae, a group with few extant species. The opportunistic species, *Platylobium tomentosum*, *Pteridium esculentum* and *T. juncea* examined in conjunction have significant cover values, and disturbance probably by fire is implied.





| CHARACTER SPECIES             | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES               | % FREQ | C/A |
|-------------------------------|--------|-----|--------------------------------|--------|-----|---------------------------------|--------|-----|
| <i>Dianella caerulea</i>      | 94     | 1   | <i>Billardiera scandens</i>    | 76     | 1   | <i>Scaevola ramosissima</i>     | 65     | +   |
| <i>Gonocarpus teucrioides</i> | 94     | 1   | <i>Poa australis</i> spp. agg. | 76     | 1   | <i>Goodenia ovata</i>           | 65     | +   |
| <i>Dampiera stricta</i>       | 88     | 1   | <i>Patersonia glabrata</i>     | 71     | 1   | <i>Hypericum gramineum</i>      | 65     | +   |
| <i>Tetralochea pilosa</i>     | 88     | 1   | <i>Entolasia marginata</i>     | 71     | 1   | <i>Leptospermum juniperinum</i> | 65     | 1   |
| <i>Epacris impressa</i>       | 88     | 1   | <i>Lomandra longifolia</i>     | 71     | 1   | <i>Lomandra filiformis</i>      | 59     | 1   |
| <i>Lepidosperma laterale</i>  | 88     | 1   | <i>Hibbertia empetrifolia</i>  | 71     | 1   | <i>Acrotriche serrulata</i>     | 59     | +   |
| <i>Persoonia linearis</i>     | 88     | 1   | <i>Viola hederacea</i>         | 71     | 1   | <i>Lindsaya linearis</i>        | 59     | 1   |
| <i>Pteridium esculentum</i>   | 88     | 1   | <i>Gahnia sieberiana</i>       | 65     | 1   | <i>Pimelea humilis</i>          | 59     | +   |
| <i>Leyeuxia quadrifida</i>    | 82     | +   | <i>Xanthorrhoea minor</i>      | 65     | 1   | <i>Eucalyptus muelleriana</i>   | 59     | 1   |
| <i>Eucalyptus sieberi</i>     | 82     | 1   | <i>Acacia myrtilifolia</i>     | 65     | 1   | <i>*Hypochoeris radicata</i>    | 53     | +   |
| <i>Burchardia umbellata</i>   | 76     | +   | <i>Platylobium formosum</i>    | 65     | 1   | <i>Eucalyptus globoides</i>     | 53     | 1   |
| <i>Tetrarrhena juncea</i>     | 76     | 1   | <i>Lomatia ilicifolia</i>      | 65     | +   |                                 |        |     |

NO. OF SITES: 16 (2.9% of total)

DISTRIBUTION: Coastal lowlands, in Marlo and Mallacoota districts.

ENVIRONMENT: Siliceous sands and clay-loams

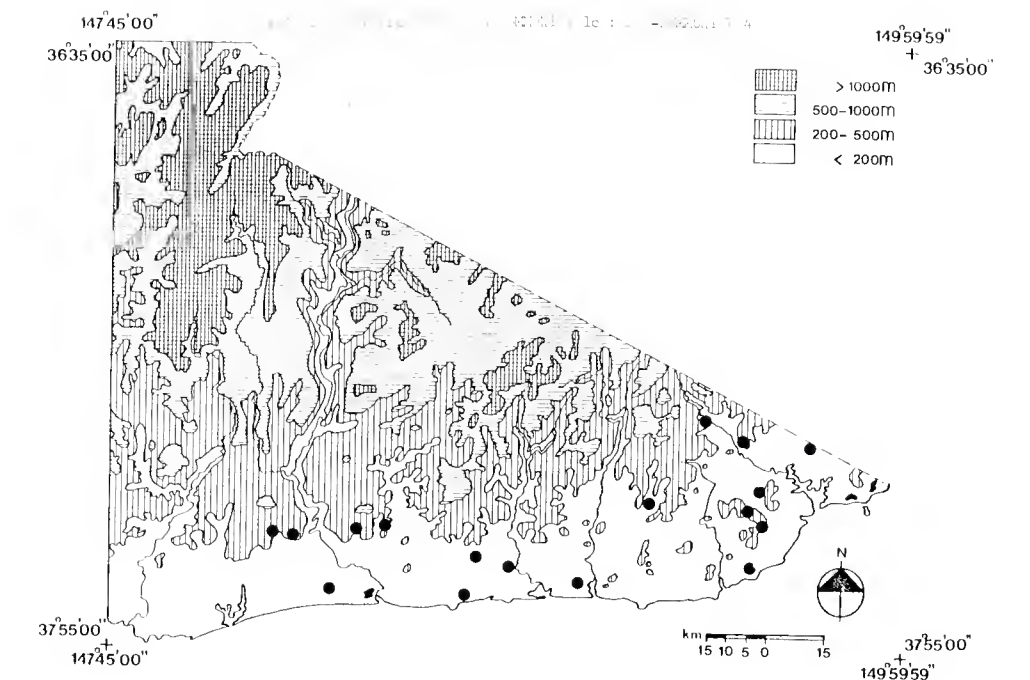
ALTITUDE: Mean = 64 m, Highest = 200 m, Lowest = 0 m.

STRUCTURE: Open-forest

MEAN FLORISTIC RICHNESS: 57 species per site

MEAN WEED COMPOSITION: 1% of species, 1% of cover

NOTES: *Eucalyptus muelleriana* shares the tree canopy with *E. sieberi* and *E. globoides* on clay-loams. A shrub layer of small-leaved sclerophyllous species occurs above a ground layer of semi-shrubs (e.g. *Dampiera stricta*, *Hibbertia empetrifolia*) and monocotyledons (e.g. *Lepidosperma laterale*, *Patersonia glabrata*). One of the few herbs present is *Hypochoeris radicata*, and it constitutes the only occurrence of an introduced character species in this Lowland Sclerophyllous Forest. The opportunistic species, *Pteridium esculentum* and *Tetrarrhena juncea* examined in conjunction have significant cover values, and disturbance, probably by fire, is implied. Nevertheless sub-community 1c. has the highest mean floristic richness within community 1c. *T. juncea* is often tangled with *Entolasia marginata*, a species of quite similar appearance.



| CHARACTER SPECIES             | FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|-------------------------------|------|-----|--------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Epacris impressa</i>       | 100  | 1   | <i>Poa australis</i> spp. agg. | 76     | 1   | <i>Helichrysum scorpioides</i> | 59     | +   |
| <i>Genocarpus teucrioides</i> | 94   | 1   | <i>Tetratheca pilosa</i>       | 76     | 1   | <i>Billardiera scandens</i>    | 53     | +   |
| <i>Dianella caerulea</i>      | 88   | 1   | <i>Dampiera stricta</i>        | 71     | 1   | <i>Cassytha phaeolasia</i>     | 53     | 1   |
| <i>Lepidosperma laterale</i>  | 88   | +   | <i>Acacia terminalis</i>       | 71     | 1   | <i>Platysace lanceolata</i>    | 53     | +   |
| <i>Lomandra longifolia</i>    | 82   | +   | <i>Persoonia linearis</i>      | 71     | 1   | <i>Leucopogon lanceolatus</i>  | 53     | +   |
| <i>Platidium osculentum</i>   | 82   | 1   | <i>Tetrarrhena juncea</i>      | 71     | 1   | <i>Pteropsonia glabrata</i>    | 53     | +   |
| <i>Eucalyptus globoidea</i>   | 82   | 1   | <i>Viola hederacea</i>         | 65     | +   | <i>Platylobium formosum</i>    | 53     | 1   |
| <i>Hibbertia empetrifolia</i> | 76   | +   | <i>Amperea xiphoclaua</i>      | 59     | +   | <i>Scaevola ramosissima</i>    | 53     | +   |
| <i>Eucalyptus sieberi</i>     | 76   | 1   |                                |        |     |                                |        |     |

NO. OF SITES: 1/ (2.9% of total)

DISTRIBUTION: Coastal lowland and foothills, from the Snowy River east to the Victoria-N.S.W. border.

ENVIRONMENT: Siliceous sands

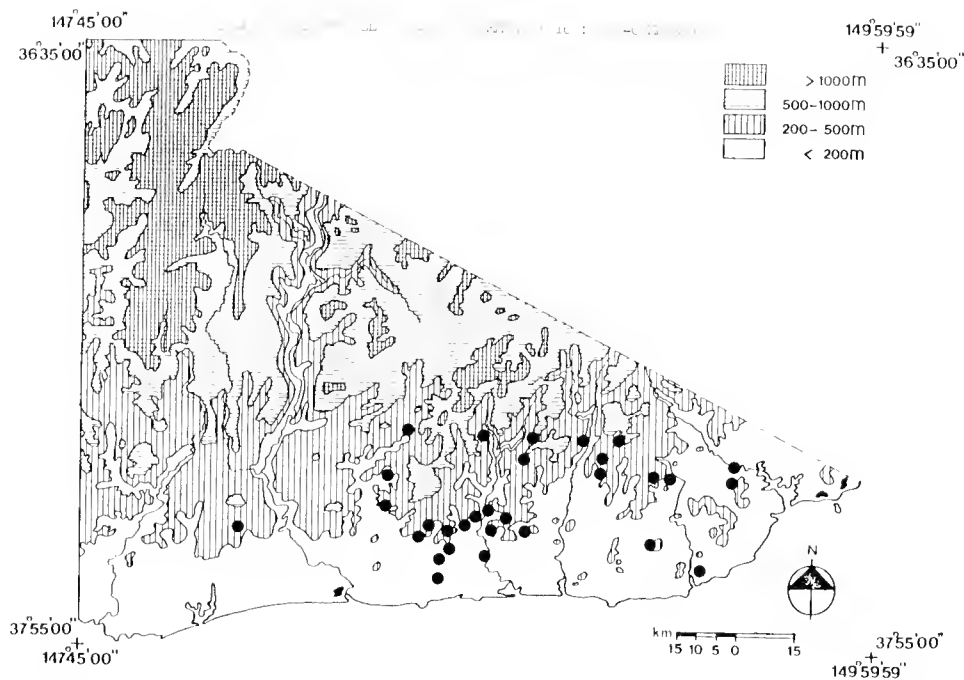
ALTITUDE: Mean = 140 m. Highest = 280 m. Lowest = 0 m.

STRUCTURE: Open-forest

MEAN FLOREST RICHNESS: 50 species per site

MEAN WOOD COMPOSITION: 0% of species, 0% of cover

NOTES: As in all other sub-communities of community 1b, *Eucalyptus sieberi* and *E. globoidea* are the major tree species. A floristically rich shrub layer (e.g. *Epacris impressa*, *Acacia botryocephala*) is developed over a range of semi-shrubs (e.g. *Tetratheca pilosa*, *Hibbertia empetrifolia*) and monocotyledons (e.g. *Dianella caerulea*, *Lepidosperma laterale*). *Cassytha phaeolasia*, a leafless parasitic twiner confined in Victoria to East Gippsland grows in tangles over host species.



| CHARACTER SPECIES             | % FRQ | C/A | CHARACTER SPECIES              | % FRQ | C/A | CHARACTER SPECIES             | % FRQ | C/A |
|-------------------------------|-------|-----|--------------------------------|-------|-----|-------------------------------|-------|-----|
| <i>Ictarrhena juncea</i>      | 94    | +   | <i>Eucalyptus globulus</i>     | 77    | 1   | <i>Amperea xiphioides</i>     | 55    | +   |
| <i>Conocarpus teucrioides</i> | 94    | 1   | <i>Epacris impressa</i>        | 74    | 1   | <i>Blechnum cartilagineum</i> | 55    | 1   |
| <i>Pteridium esculentum</i>   | 90    | 1   | <i>Persoonia linearis</i>      | 74    | 1   | <i>Alsophila australis</i>    | 55    | +   |
| <i>Dianella caerulea</i>      | 90    | 1   | <i>Hibbertia empetrifolia</i>  | 71    | 1   | <i>Lomatia ilicifolia</i>     | 55    | 1   |
| <i>Viola hederacea</i>        | 87    | +   | <i>Leucopogon lancolatus</i>   | 71    | 1   | <i>Lomandra longifolia</i>    | 55    | 1   |
| <i>Billardiera scandens</i>   | 81    | +   | <i>Acacia mucronata</i>        | 68    | 1   | <i>Eucalyptus obliqua</i>     | 55    | 1   |
| <i>Goodenia ovata</i>         | 81    | 1   | <i>Lepidosperma laterale</i>   | 68    | 1   | <i>Casuarina longifolia</i>   | 48    | +   |
| <i>Cassytha phaeolasia</i>    | 77    | 1   | <i>Poa australis</i> spp. agg. | 61    | 1   | <i>Tylophora barbata</i>      | 48    | 1   |
| <i>Eucalyptus sieberi</i>     | 77    | 1   | <i>Gunnia sieberiana</i>       | 61    | 1   | <i>Covisia uncinifolia</i>    | 48    | 1   |
| <i>Hierochloa rariflora</i>   | 77    | 1   | <i>Correa reflexa</i>          | 58    | 1   | <i>Culcita dubia</i>          | 45    | 1   |
| <i>Tetrarhena pilosa</i>      | 77    | 1   | <i>Platylobium formosum</i>    | 58    | 1   | <i>Pultanea daphnoides</i>    | 45    | 1   |

NO. OF SITES: 31 (5.3% of total)

DISTRIBUTION: Coastal lowland and foothills, from the Hawy River east to the Victoria-Melb. border.

ENVIRONMENT: Siliceous sand and sandy-loams, often in minor gullies

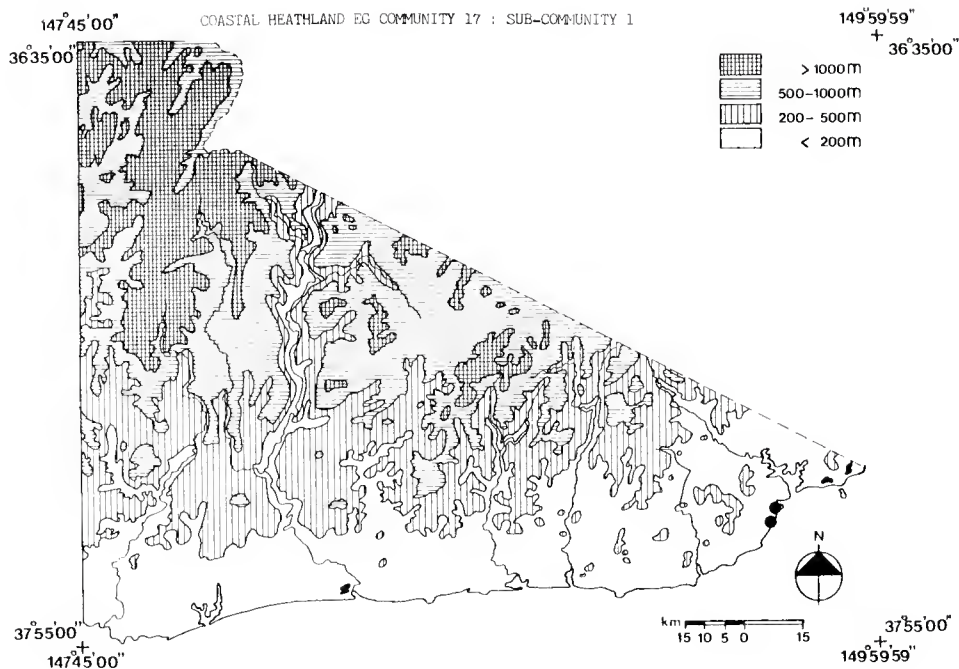
ALTITUDE: Mean = 107 m, Highest = 440 m, Lowest = 40 m.

STRUCTURE: Open-forest to Tall open-forest

MEAN FLORISTIC RICHNESS: 48 species per site

MEAN WEED COMPOSITION: 1% of species, 0% of cover

NOTES: The occurrence of *Eucalyptus obliqua* in this sub-community, along with the ferns *Culcita dubia*, *Alsophila australis* and *Blechnum cartilagineum*, suggest a relationship with the higher altitude forests such as those of community 13.1. The shrub layer has a significant complement of opportunistic species (*Pteridium esculentum*, *Goodenia ovata*, *Acacia mucronata*, *Platylobium formosum*, *Gunnia sieberiana*, *Casuarina longifolia*) which often occur with high cover values suggesting disturbance is a result of fire or forestry operations. The attractive, coumarin-scented grass, *Hierochloa rariflora* and the robust, tangled wire-grass *Tetrarhena juncea* may also form unbroken swards after disturbance.



| CHARACT. SPECIES               | % FREQ. | C/A | CHARACT. SPECIES               | % FREQ. | C/A | CHARACT. SPECIES               | % FREQ. | C/A |
|--------------------------------|---------|-----|--------------------------------|---------|-----|--------------------------------|---------|-----|
| <i>Acacia myrtifolia</i>       | 100     | +   | <i>Limnocarya linearis</i>     | 100     | 1   | <i>Pimelea laevifolia</i>      | 67      | 1   |
| <i>Emmelia marginata</i>       | 100     | +   | <i>Peterssonia glabrata</i>    | 100     | 1   | <i>Poa australis</i> spp. agg. | 67      | 1   |
| <i>Podocarpus prostratus</i>   | 100     | +   | <i>Scaevola ramosissima</i>    | 100     | +   | <i>Stipa nervosa</i>           | 67      | 1   |
| <i>Paraphanthera umbellata</i> | 100     | 1   | <i>Schoenus apogon</i>         | 100     | +   | <i>Stipa semibarbata</i>       | 67      | 1   |
| <i>Leptocarpus pilosus</i>     | 100     | 1   | <i>Schoenus brevifolius</i>    | 100     | 1   | <i>Acrotriche serrulata</i>    | 67      | 1   |
| <i>Leptocarpus pilosus</i>     | 100     | 1   | <i>Scaevola viminea</i>        | 100     | 1   | <i>Amperea xiphioides</i>      | 67      | +   |
| <i>Leptocarpus pilosus</i>     | 100     | +   | <i>Hemelia australis</i>       | 100     | 1   | <i>Empodisma minus</i>         | 67      | 1   |
| <i>Leptocarpus pilosus</i>     | 100     | 1   | <i>Thysanotus junceifolius</i> | 100     | +   | <i>Conosperma ericinum</i>     | 67      | 1   |
| <i>Leptocarpus pilosus</i>     | 100     | 1   | <i>Xanthosia pusilla</i>       | 100     | +   | <i>Gahnia radula</i>           | 67      | 1   |
| <i>Leptocarpus pilosus</i>     | 100     | +   | <i>Anisopogon avenaceus</i>    | 67      | 2   | <i>Goodenia ovata</i>          | 67      | 1   |
| <i>Leptocarpus pilosus</i>     | 100     | 1   | <i>Astroloma humifusum</i>     | 67      | 1   | <i>Hibbertia empetrifolia</i>  | 67      | 1   |
| <i>Leptocarpus pilosus</i>     | 100     | 1   | <i>Chamaecilla corymbosa</i>   | 67      | 1   | <i>Platysace heterophylla</i>  | 67      | 1   |
| <i>Leptocarpus pilosus</i>     | 100     | 1   | <i>Cyatochaeta diandra</i>     | 67      | 1   | <i>Platysace lanceolata</i>    | 67      | 1   |
| <i>Leptocarpus pilosus</i>     | 100     | +   | <i>Oreocera auriculata</i>     | 67      | +   | <i>Schoenus tenuissimus</i>    | 67      | 1   |
| <i>Leptocarpus pilosus</i>     | 100     | +   | <i>Euphrasia collina</i>       | 67      | 1   | <i>Selaginella uliginosa</i>   | 67      | 1   |
| <i>Leptocarpus pilosus</i>     | 100     | 1   | <i>Lomandra filiformis</i>     | 67      | +   | <i>Xanthosia dissecta</i>      | 67      | +   |
| <i>Leptocarpus pilosus</i>     | 100     | 1   | <i>Opercularia varia</i>       | 67      | +   |                                |         |     |

No. of Sites: 3 (0.5% of total)

DISTRIBUTION: restricted to near-coastal plains between Betka River and Seal Creek.

ENVIRONMENT: cliff-top plateau within 1 km of the sea. Buffered from strong, salt-laden winds by sea cliff and a dense band of shrubland vegetation (such as 19.1 and 20.1)

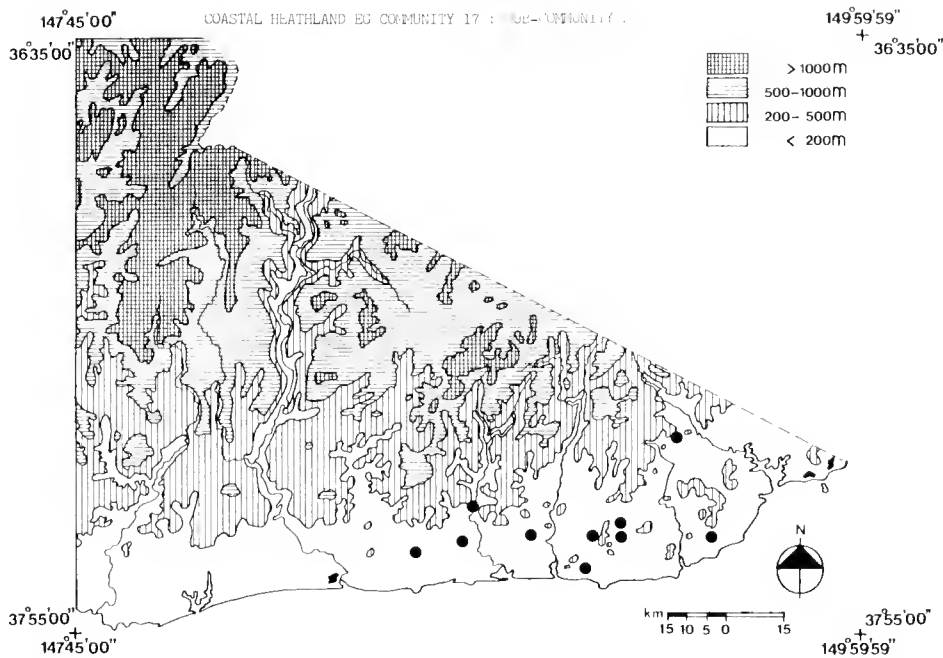
ELEVATION: Mean = 30 m, Highest = 40 m, Lowest = 20 m.

STRUCTURE: open-heath

RAV. FLORESTA: 44 species per site

MEAN SPEC. COMPOSITION: 0% of species, 0% of cover

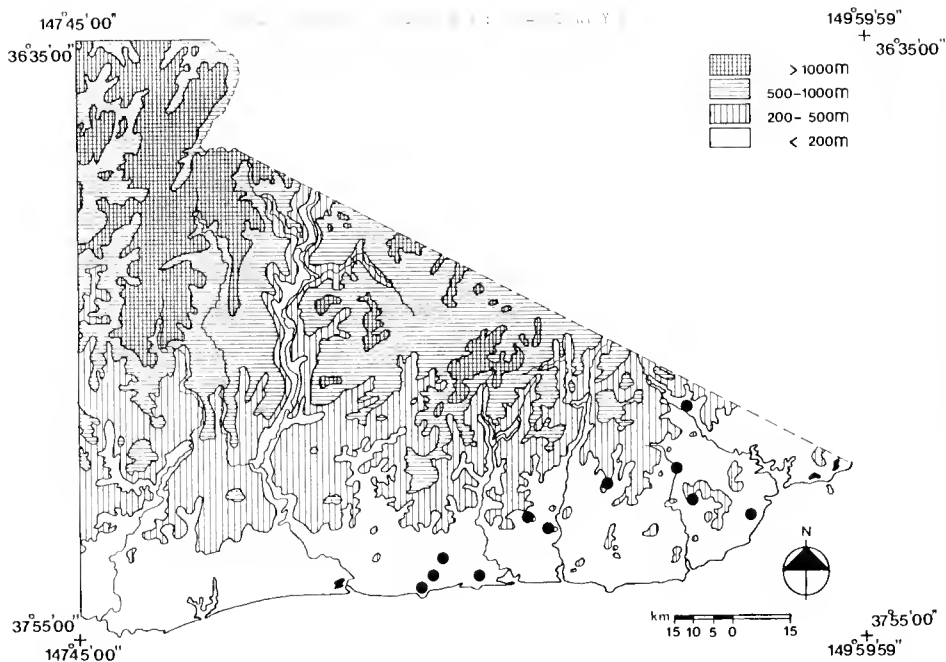
Notes: Grasses, sedges and lilies form an unusually high proportion of the species in this coastal heath sub-community. Character species, *Cyatochaeta diandra* and *Thysanotus junceifolius*, are rare in Victoria and restricted to this region. *Epidium cinereum*, a species of very disjunct distribution, is found only here and in the north-eastern Grampians.



| CHARACTER SPECIES               | % FREQ | C/A | CHARACTER SPECIES               | % FREQ | C/A | CHARACTER SPECIES             | % FREQ | C/A |
|---------------------------------|--------|-----|---------------------------------|--------|-----|-------------------------------|--------|-----|
| <i>Gelaginella uliginosa</i>    | 100    | 1   | <i>Epacris impressa</i>         | 73     | 1   | <i>Lindsaya linearis</i>      | 64     | 1   |
| <i>Xanthorrhoea hastilis</i>    | 100    | 2   | <i>Burchardia umbellata</i>     | 73     | +   | <i>Gahnia clarkii</i>         | 55     | 1   |
| <i>Lumpiera stricta</i>         | 91     | 1   | <i>Epacris obtusifolia</i>      | 73     | 1   | <i>Banksea serrata</i>        | 55     | 1   |
| <i>Melaleuca squarrosa</i>      | 91     | 2   | <i>Dillwynia glaberrima</i>     | 64     | 1   | <i>Comeosperma cricium</i>    | 55     | 1   |
| <i>Leptospermum juniperinum</i> | 91     | 1   | <i>Gonocarpus tetradoloides</i> | 64     | +   | <i>Lepidosperma filiforme</i> | 55     | 2   |
| <i>Empodisma minus</i>          | 82     | 1   | <i>Gahnia sieberiana</i>        | 64     | 1   | <i>Sprongelia incarnata</i>   | 55     | 1   |
| <i>Cassytha glabella</i>        | 82     | 1   | <i>Actus ericoides</i>          | 64     | +   |                               |        |     |

|                          |  |
|--------------------------|--|
| NO. OF SITES:            | 10 (11% of total)  |
| DISTRIBUTION:            | Frequent between Mario and Little Ham Head and up to 20 km inland, with an outlying occurrence west of the Genoa River near Wangarabell. |
| ENVIRONMENT:             | Depressions and poorly drained plains within undulating, near-coastal regions. Sites are generally peaty sands.                          |
| ALTITUDE:                | Mean = 89 m, Highest = 120 m, Lowest = 70 m.   |
| STRUCTURE:               | Closed-heath   |
| MEAN FLORISTIC RICHNESS: | 4.2 species per site   |
| MEAN WEED COMPOSITION:   | 0% of species, 0% of cover   |

NOTE: This distinct vegetation type, restricted in Victoria to East Gippsland, is widely known as "grass-tree plain" and dominated by *Xanthorrhoea hastilis* (Spear Grass-tree). This sub-community lacks any arborescent plants and is often extensive. Despite frequent burning and seasonal grazing, many ephemeral species and orchids persist in this sub-community (e.g. *Drosera*, *Utricularia* and *Prasophyllum* spp.).



| CHARACTER SPECIES               | % FREQ | C/A | CHARACTER SPECIES             | % FREQ | C/A | CHARACTER SPECIES                 | % FREQ | C/A |
|---------------------------------|--------|-----|-------------------------------|--------|-----|-----------------------------------|--------|-----|
| <i>Xanthorrhoea hastilis</i>    | 100    | 2   | <i>Burchardia umbellata</i>   | 75     | +   | <i>Xyris operculata</i>           | 67     | 1   |
| <i>Casuarina paludosa</i>       | 92     | 1   | <i>Cassytha glabella</i>      | 75     | +   | <i>Linusaya linearis</i>          | 67     | 1   |
| <i>Leptocarpus tenax</i>        | 92     | 1   | <i>Dampiera stricta</i>       | 75     | +   | <i>Gonocarpus teucrioides</i>     | 58     | 1   |
| <i>Leptospermum juniperinum</i> | 92     | 1   | <i>Hakea teretifolia</i>      | 75     | 1   | <i>Gahnia sieberana</i>           | 58     | 1   |
| <i>Rhipidiana minus</i>         | 83     | 1   | <i>Lepidosperma filiforme</i> | 75     | 1   | <i>Patersonia fragilis</i>        | 58     | 1   |
| <i>Restio complanatus</i>       | 83     | 1   | <i>Epacris impressa</i>       | 67     | 1   | <i>Tetraria capillaris</i>        | 58     | 1   |
| <i>Selaginella uliginosa</i>    | 83     | 1   | <i>Sprengelia incarnata</i>   | 67     | 1   | <i>Tetrarrhena distichophylla</i> | 58     | 1   |

NO. OF SITES: 13 (2.2% of total)

DISTRIBUTION: Near-coastal plains between Marlo and Berm River, but extending to 30 km inland near Genoa.

ENVIRONMENT: Damp depressions within near-coastal plains. Soils are of peaty sands or deep siliceous sand on harupan base

ALTITUDE: Mean = 80 m, Highest = 160 m, Lowest = 40 m.

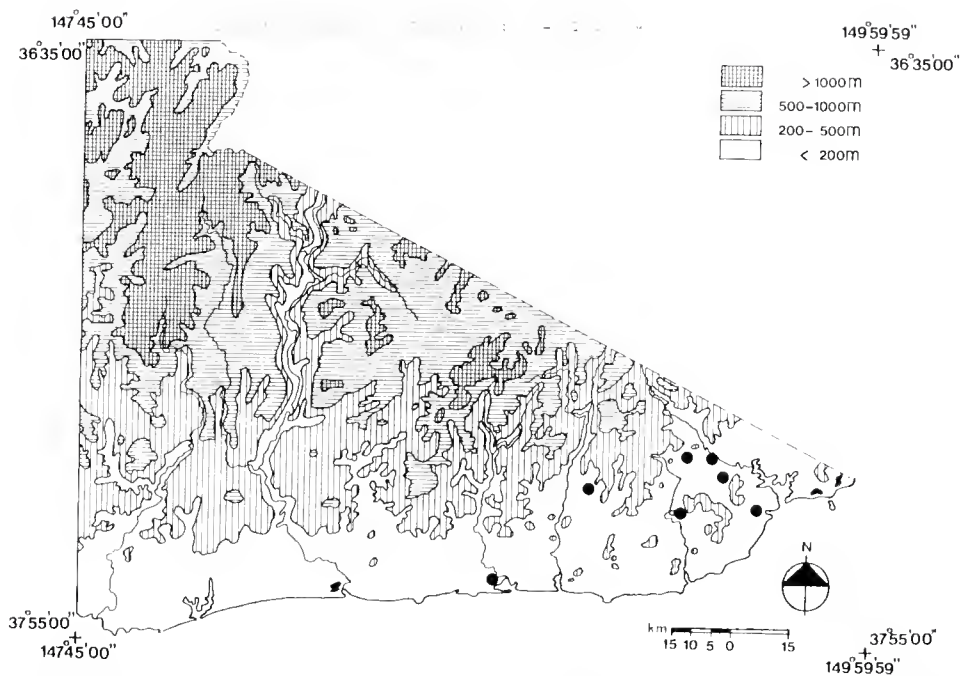
STRUCTURE: Closed-heath

MEAN FLORISTIC RICHNESS: 4.3 species per site

MEAN WEED COMPOSITION: 0% of species, 0% of cover

NOTES: A version of grass-tree plain in which both *Casuarina paludosa* and *Xanthorrhoea hastilis* constitute the major species. This vegetation type occupies wetter sites than those supporting sub-community 17.2 a feature reflected in the presence of *C. paludosa* and other wetland species such as *Xyris operculata*, *Patersonia fragilis* and *Sprengelia incarnata*.





| CHARACTER SPECIES               | % FREQ | C/A | CHARACTER SPECIES           | % FREQ | C/A | CHARACTER SPECIES             | % FREQ | C/A |
|---------------------------------|--------|-----|-----------------------------|--------|-----|-------------------------------|--------|-----|
| <i>Epodisma minus</i>           | 100    | 1   | <i>Spargis lanuginosa</i>   | 63     | 1   | <i>Lindseyi linearis</i>      | 67     | 1   |
| <i>Clasyna glabella</i>         | 100    | +   | <i>Lumandra longifolia</i>  | 63     | 1   | <i>Callistemon citrinus</i>   | 67     | 1   |
| <i>Lasuarina paludosa</i>       | 100    | 1   | <i>Amperea xiphocaula</i>   | 67     | +   | <i>Clavea teretifolia</i>     | 67     | 1   |
| <i>Leptospermum juniperinum</i> | 100    | 1   | <i>Anisopogon avenaceus</i> | 67     | +   | <i>Hypericum gramineum</i>    | 67     | 1   |
| <i>Delaginella uliginosa</i>    | 100    | 1   | <i>Eurhardia umbellata</i>  | 67     | +   | <i>Lepidosperma nassii</i>    | 67     | +   |
| <i>Banksia serrata</i>          | 63     | 1   | <i>Eucalyptus globoidea</i> | 67     | 1   | <i>Sphaerolobium vimineum</i> | 67     | 1   |
| <i>Ampiera stricta</i>          | 63     | 1   | <i>Conocarpus leucoides</i> | 67     | 1   |                               |        |     |

NO. OF SITES: 6 (1.5% of total)

DISTRIBUTION: Uncommon from Marlo to Cape Conrat, and scattered between Long River, Gunga and Kallacoota.

ENVIRONMENT: Near Marlo, immediately leeward of the foredunes, otherwise in damp depressions of the near-coastal plains

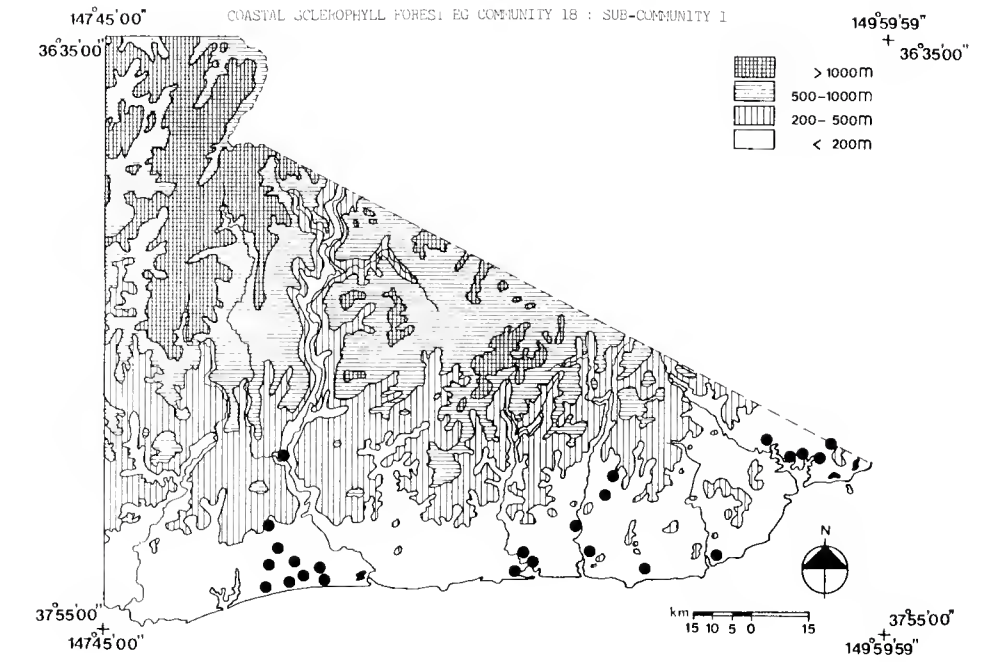
ALTITUDE: Mean = 76 m, Highest = 120 m, Lowest = 40 m.

STRUCTURE: Closed-heath

MEAN FLORISTIC RICHNESS: 36 species per 1 ha

MEAN WEED COMPOSITION: 0% of species, 3% of cover

Notes: This sub-community, dominated by *Lasuarina paludosa*, replaces the grass-tree plain vegetation in wetter areas of deep sandy soils. Sub-community 17.6 has greater floristic affinities with the surrounding open-forest than to 17.1, 17.2 or 17.3. *Banksia serrata*, *Conocarpus leucoides*, *Lumandra longifolia* and *Pteridium esculentum* are some of the species shared with the forest. On exposed, sea-facing slopes the height of the tallest plants of this vegetation may not exceed 1.5 m, but sheltered sites, such as dune swales, may support much taller (> 1.5 m) vegetation.



| CHARACTER SPECIES     | % FREQ | C/A | CHARACTER SPECIES         | % FREQ | C/A | CHARACTER SPECIES   | % FREQ | C/A |
|-----------------------|--------|-----|---------------------------|--------|-----|---------------------|--------|-----|
| Pteridium caudatum    | 90     | 1   | Microlaena stipitata      | 59     | +   | Glycine clandestina | 48     | 1   |
| Nicola hederacea      | 79     | +   | Poa australis spp. agg.   | 59     | 1   | Dianella caerulea   | 48     | 1   |
| Leandra longifolia    | 76     | 1   | Tylophora barbata         | 55     | 1   | Echinopogon ovatus  | 46     | +   |
| Senecio carpinifolius | 69     | 1   | Geranium potentillifolium | 52     | +   | Galium gaudichaudii | 48     | +   |
| Eucalyptus botryoides | 66     | 1   | Dichonora repens          | 52     | +   |                     |        |     |

NO. OF SITES: 28 (4.9% of total)

DISTRIBUTION: Common in near-coastal regions and around the lower reaches of the Snowy, Cann, Berni and Genoa Rivers.

ENVIRONMENT: Moist, sheltered sites throughout the lowlands

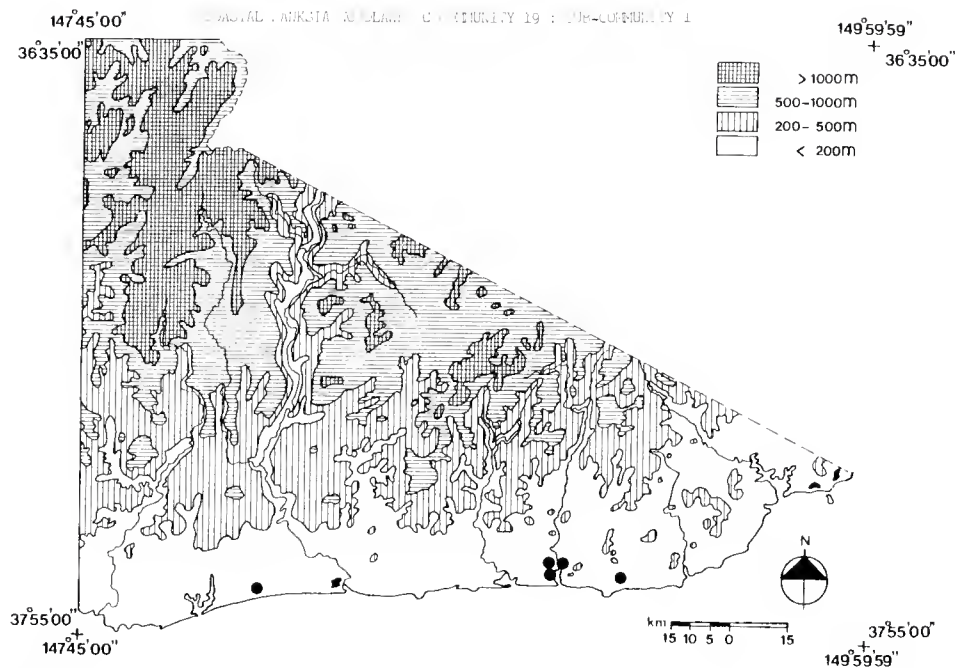
ALTITUDE: Mean = 32 m, Highest = 80 m, Lowest = 0 m.

STRUCTURE: Open-forest

PLANT-LOGISTIC RECORDS: 47 species per site

MEAN SPECIES COMPOSITION: 4% of species, 3% of cover

NOTE: This riparian sub-community also contains elements of heathland and coastal open-forest communities. This feature is indicative of the environment of this sub-community. Riparian lowland vegetation in Victoria has largely disappeared in the wake of agricultural pursuits. This sub-community although comprising few rare or restricted species, is therefore an example of a diminishing vegetation type within the state.



| PLANT SPECIES                 | % FREQ | C/A | CHARACTER SPECIES               | % FREQ | C/A | CHARACTER SPECIES              | % FREQ | C/A |
|-------------------------------|--------|-----|---------------------------------|--------|-----|--------------------------------|--------|-----|
| <i>Banksia integrifolia</i>   | 100    | 1   | <i>Eucalyptus botryoides</i>    | 86     | 1   | <i>Lepidosperma canavum</i>    | 71     | 1   |
| <i>Dianella tasmanica</i>     | 100    | +   | <i>Pteridium esculentum</i>     | 56     | 1   | <i>Melaleuca ericifolia</i>    | 71     | 1   |
| <i>Claoxarpus reticulatus</i> | 100    | 1   | <i>Banksia serrata</i>          | 71     | 1   | <i>Asperula xiphioides</i>     | 57     | 1   |
| <i>Lomandra longifolia</i>    | 100    | +   | <i>Ptilinocarpos pinifolius</i> | 71     | +   | <i>Geocoma ovata</i>           | 57     | 1   |
| <i>Casuarina phaeoloba</i>    | 86     | +   | <i>Acacia longifolia</i>        | 71     | 1   | <i>Melaleuca squarrosa</i>     | 57     | 1   |
| <i>Salvinia clarkii</i>       | 86     | 2   | <i>Epacris impressa</i>         | 71     | 1   | <i>Tetrarrhena juncea</i>      | 57     | 1   |
| <i>Conoclinium elliptica</i>  | 56     | 1   | <i>Pultenaea capinoides</i>     | 71     | +   | <i>Dianella caerulea</i>       | 57     | +   |
| <i>Platylobium formosum</i>   | 86     | +   | <i>Gonocarpus teucrioides</i>   | 71     | 1   | <i>Poa australis</i> spp. var. | 57     | 1   |

NO. OF SITES: 7 (1.3% of total)

DISTRIBUTION: Recorded only between Tamboon Inlet and the mouth of the Thurna River but probably more widespread than sampling indicates.

ENVIRONMENT: Areas of drainage or inundation with a strong coastal influence but sheltered from direct ocean winds.

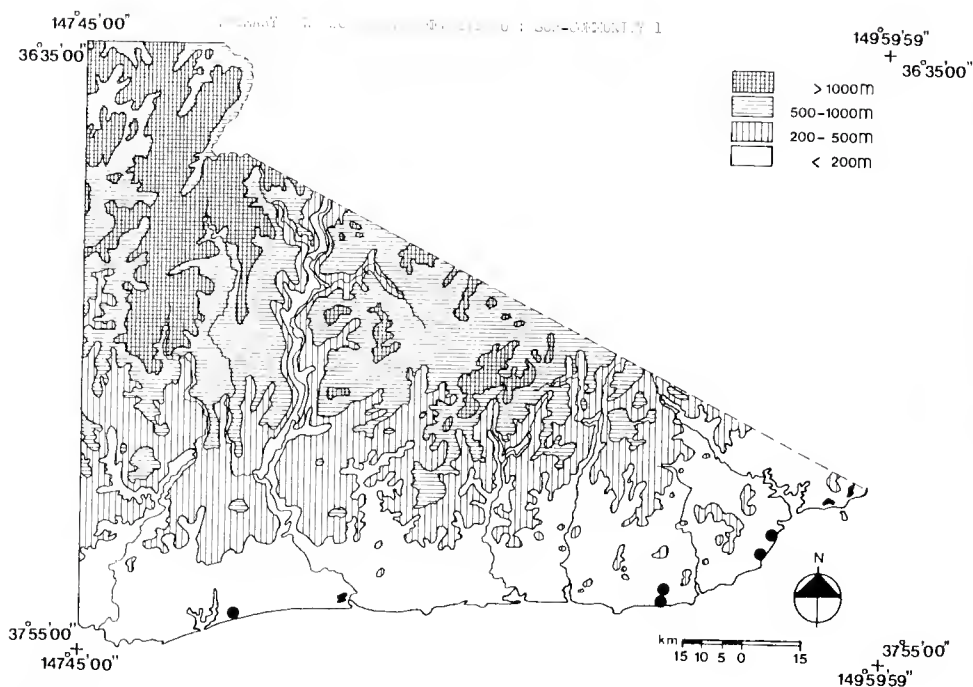
ALTITUDE: Mean = 36 m, Highest = 40 m, Lowest = 10 m.

STRUCTURE: Woodland

MEAN FLORESTIC RICHNESS: 50 species per site

MEAN WEED COMPOSITION: 4% of species, 3% of cover

NOTES: Dense thickets of *Melaleuca ericifolia*, *M. squarrosa* and *Gahnia clarkii* are a constituent of this *Poa* *integrifolia* - *Eucalyptus botryoides* woodland. Within these thickets, species numbers are low and a large complement of the species at any site are those which occur more commonly within the surrounding vegetation.



| CHARACTER SPECIES               | % FREQ | C/A | CHARACTER SPECIES           | % FREQ | C/A | CHARACTER SPECIES          | % FREQ | C/A |
|---------------------------------|--------|-----|-----------------------------|--------|-----|----------------------------|--------|-----|
| <i>Carpobrotus rostrii</i>      | 100    | 1   | <i>Myoporum insulare</i>    | 83     | 1   | <i>Spinifex hirsutus</i>   | 67     | 1   |
| <i>Delichrysium parvifolium</i> | 100    | 1   | <i>Senecio lautus</i>       | 83     | +   | <i>Acaena aserinifolia</i> | 67     | 1   |
| <i>Leptospermum laevigatum</i>  | 100    | 1   | <i>Acacia longifolia</i>    | 67     | 2   | <i>Correa alba</i>         | 67     | 1   |
| <i>Chlorophthalmus brownii</i>  | 63     | 1   | <i>Olearia axillaris</i>    | 67     | 1   | <i>Oxalis corniculata</i>  | 67     | +   |
| <i>Banksia integrifolia</i>     | 63     | 1   | <i>Actites megalocarpus</i> | 67     | +   | <i>Scirpus nodosus</i>     | 67     | 1   |

MEAN SIZE: 6 (1.0% of total)

DISTRIBUTION: Along the coast throughout the study area.

ENVIRONMENT: exposed foredunes or seacliffs with substrates, respectively, of pure calcareous sand or sedimentary rock

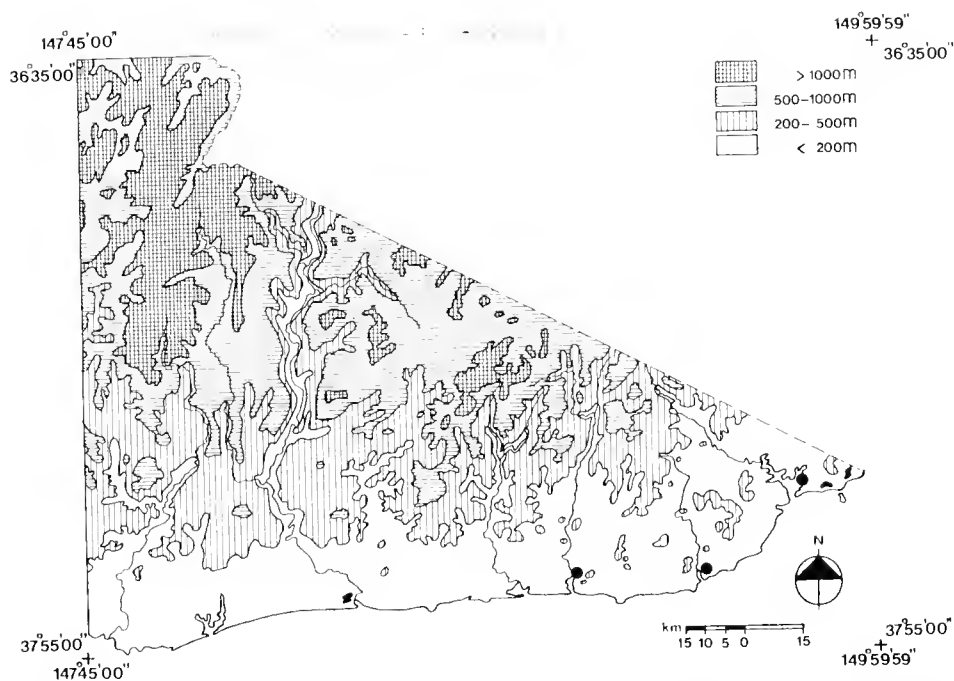
ALTITUDE: Mean = 20 m, Highest = 40 m, Lowest = 0 m.

STRUCTURE: Low-shrubland

MEAN FLORISTIC RICHNESS: 27 species per site

MEAN WEED COMPOSITION: 4% of species, 2% of cover

NOTE: This is a floristically depauperate sub-community but one which is well-adapted to the exposed, seafront environment. It is widespread along the Victorian coastline throughout which range the species composition is largely unaltered. The rhizomatous growth habit of some, and extensive root systems of most species of sub-community '20.1' contribute to the important function of dune stabilization. The protection from strong, salt winds afforded by the foredunes is essential for the maintenance of communities further inland.



| CHARACTER SPECIES        | FEQ. | C% | CHARACTER SPECIES           | FEQ. | C% | CHARACTER SPECIES              | FEQ. | C% |
|--------------------------|------|----|-----------------------------|------|----|--------------------------------|------|----|
| <i>Juncus kraussii</i>   | 100  | +  | <i>Melaleuca ericifolia</i> | 67   | +  | <i>Surf-trees russii</i>       | 67   | +  |
| <i>Samolus repens</i>    | 100  | 1  | <i>Apium prostratum</i>     | 67   | +  | <i>Salicornia quinqueflora</i> | 67   | +  |
| <i>Selliera radicans</i> | 100  | +  | <i>Aster subulatus</i>      | 67   | 1  | <i>Suaeda australis</i>        | 67   | 1  |
| <i>Suaeda juncea</i>     | 67   | +  |                             |      |    |                                |      |    |

N.O. OF SITES: 3 (6.2% of total)

DISTRIBUTION: Restricted to the estuaries of the River, Cam, Tweller, Mangan and Senca Rivers.

ENVIRONMENT: Alluvial muds or silts bordering sheltered shallow waters of variable salinity

ALTITUDE: 0 m.

STRUCTURE: Tussock-grassland and interdicting herbland

MEAN FLORESTA RICHNESS: 16 species per site

MEAN WEI COMPOSITION: 6% of species, 4% of cover

NOTES: This sub-community, dominated by *Juncus kraussii* occupies the same zone as the saltmarsh communities (i.e. between shorefront and *Melaleuca ericifolia* shrubland) common elsewhere in Victoria. Shrubby plants (particularly *Arthrocnemum* spp.) dominate the latter communities but are absent from 21.1. However, most species characteristic of 21.1 (*Apium prostratum*, *Samolus repens*, *Selliera radicans*, *Salicornia quinqueflora*, *Suaeda australis*) are common in saltmarsh vegetation.





# A NEW AUSTRALIAN LICHEN: CLADONIA SULCATA

by

A. W. ARCHER\*

Psoromic acid is a relatively uncommon  $\beta$ -depsidone in the lichen genus *Cladonia*. About 5% (14 out of 276) of the species and varieties of *Cladonia* of which the chemistry is known (Culberson 1969, 1970; Culberson, Culberson and Johnson, 1977) contain psoromic acid and of these 14 only three contain psoromic acid and atranorin. These are *C. norrlinii* Vain. (Vainio, 1922) from north America (Thomson, 1967) and Europe (Ahti, 1977), *C. subconistea* Asah. from Japan (Asahina, 1941) and Taiwan (Ahti and Lai, 1979) and *C. dahliana* Kristinsson reported to occur in Iceland, Greenland and Baffin Island (Kristinsson, 1974). A recent chemical examination of material from Victoria and Tasmania, tentatively identified as *C. diffissa* (F. Wils.) F. Wils. (Wilson, 1889, 1889a), showed some specimens to contain atranorin and psoromic acid, in contrast to the atranorin and norstictic acid found in *C. diffissa*. The specimens containing atranorin and psoromic acid were not referable to *C. norrlinii*, *C. subconistea* or *C. dahliana* and are here differentiated as a separate species.

## DESCRIPTION

***Cladonia sulcata*** A. W. Archer, sp. nov.

Thallus primarius squamulis, 1-3 mm longis, 0.3-1.5 mm latis, supra cinero-glauciscentibus, infra albis, nullis sorediis. Podetia ascendentia squamulis, 10-20 mm altum, nullis scyphis, parte supra ramosa, superficiebus sulcatis et subindescentia, cortice continuo subgranularescenti. Apotheciis ad apices podetiorum, fuscis, convexis, 0.3-0.6 mm diam. Ascospores non videt. Thallus K+ flavescens, C-, Pd+ flavus. Atranorinum et acidum psoromicum continens.

*Primary thallus* with squamules, 1-3 mm long, 0.3-1.5 mm wide, upper side pale green, below white, esorediate. *podetia* arising from the squamules, 10-20 mm tall, lacking scyphi, grooved and becoming somewhat split; *cortex* continuous, becoming somewhat granular; *apothecia* on the tips of the podetia, dark brown, convex, 0.3-0.6 mm diam.; *ascospores* not seen. Thallus K+ weak yellow, C-, Pd+ yellow; containing atranorin and psoromic acid.

The presence of atranorin and psoromic acid was demonstrated by thin-layer chromatography and the identity of the compounds confirmed by co-chromatography with authentic samples of the two compounds.

**TYPE COLLECTION:** Australia, Victoria, 8 km east of Tawonga, on soil by side of Trapper's Creek Road, approximately 147°15'E, 36°41'S, altitude ca 700 m, 22.xi.1979, *Archer 803* (Holotype: MEL 1031486; Isotype: H, COLO).

## ALSO EXAMINED:

*Victoria*—ca 2 km north of holotype collection site, 22.xi.1979, *Archer 860A* (MEL 1031487).

*Tasmania*—7 km north-east of Derwent Bridge, on soil by side of track near Cynthia Bay, Lake St. Clair, approximately 146°10'E, 42°7'S, altitude ca 700 m, 2.iii.1980, *Archer 889* (MEL 1031488).

## DISCUSSION

The specific epithet *sulcata* refers to the grooved appearance of the podetia. Typical specimens are illustrated in figure 1.

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*Muelleria* 5(1): 115-117 (1982).



Fig. 1. *Cladonia sulcata*. Typical specimens showing podetia with apothecia. Scale in millimetres.

*Cladonia sulcata* is a member of the *C. cariosa* group and thus differs from the two Australian *Cladonia* species reported as containing psoromic acid. These are *C. staufferi* des Abb. (des Abbaycs, 1966), a scyphose species first reported from Mt. Baw Baw, Victoria and an undescribed scyphose sub-alpine species (*Cladonia* sp. B, Dahl, 1970).

The new species differs from the superficially similar *C. diffissa* by the presence of psoromic acid and also in possessing less fissured podetia which, by exposing less of the white internal medullary hyphae, give *C. sulcata* a greenish appearance compared to the greyish-white appearance of *C. diffissa*. This latter feature is particularly noticeable when the two species are seen growing side by side as at the type location.

Psoromic acid also distinguishes *C. sulcata* from *C. corymbescens* Nyl. ex Leighton, which may occur in south-east Australia with *C. diffissa* but which contains atranorin and fumarprotocetraric acid.

The smaller squamules of *C. sulcata* distinguish this species from *C. dahliana* of the northern hemisphere and also from a chemical variety of *C. symphylicarpa* (Ach.) Fr., containing atranorin and psoromic acid, reported from the Great Lakes region of North America (Harris, 1975). The esorediate fissured podetia of *C. sulcata* provide a morphological distinction from the chemically similar but sorediate *C. norlinii* and from *C. subconistea*, an esorediate scyphose species.

#### ACKNOWLEDGEMENTS

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